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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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VOL. XXVIII NO. 9 SAN FRANCISCO, MARCH 2, 1912 PER COPY, 25 CENTS

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O-B Extruded Ears

O-B Extruded Trolley Ear — Patent Applied For

Interesting Ear Data—

The unprecedented results secured from the Extruded Ear in service tests under very heavy traffic and the severest conditions warrant us in claiming that it has about twice the life of an ordinary ear.

On questioning several large city roads we found that under heavy service, the average trolley wire outlasts six ordinary trolley ears.

The cost of replacing a large number of ears on a continuous stretch of line averages about one-half the first cost of each ear but—when only one or two ears have to be replaced in an emergency, it costs many times the first cost of the ears.

Apply the above to your own conditions and figure the saving that the use of Extruded Ears will mean to you. Remember it will be not only one-half the first cost of the Ears but one-half of the big item of installation in every case.

General Description—

The Extruded Ear consists of two parts, a runner piece and a boss. The boss is made of malleable iron, sherardized, and is pressed upon the runner piece and securely riveted in place.

The runner piece, which grips the trolley wire in the same way as a regular Clinch Ear, is made by a hydraulic ram which is brought to bear on a red hot billet of cast bronze and forces or "extrudes" the metal through a die under several tons of pressure.

This process imparts a wonderful density to the metal, insures absolute uniformity in all dimensions and prevents blow holes, cracks and "rotten spots" which sometimes occur in cast ears.

Extruded metal has a tensile strength of 70,000 lbs. per square inch, an elastic limit of 50,000 lbs., and an elongation of 33 1-3%.

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Due to the above physical characteristics, Extruded Ears will last about twice as long as cast ears.

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The Extruded Ear retains its hold upon the wire at the ends just as well as in the middle so that the ends do not curl up after being installed. The malleable iron boss prevents trouble from stripping of the threads.

We want you to give Extruded Ears a trial and prove our claims of long life, ease of installation and minimum wear to trolley wheels, to your own satisfaction. Do not lose this chance to reduce maintenance expenses.

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JOURNAL OF ELECTRICITY
POWER AND GAS
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VOLUME XXVIII SAN FRANCISCO, MARCH 2, 1911 NUMBER 9

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THE DEVELOPMENT OF THE TURBINE

BY GEORGE J. HENRY Jr.

Much might be written about the historical development of prime movers actuated by water, but it is not here intended to cover the historical field more than to crystalize the steps that bring us to the period of the last 75 years, since which the development has been most interesting and rapid.

From the earliest times of the Egyptians are found most ingenious devices for utilizing the kinetic energy of moving water to actuate mechanism of various kinds, to suit the purposes of what was then a highly organized civilization, a civilization, however, of mysticism and superstition and indeed priest-ridden to a degree found only among pagan nations. During a period of national development, when the channels of education, travel and communication were inaccessible to all but a chosen few, and so restricted in fact that a lifetime spent in the pursuit of knowledge resulted in a fund of general information that a seven-year-old school boy could today put to shame, so warped was this information from the real facts, as we know them today, that so-called common sense now puts to rout many of the convictions of the ancients, and even those of the medieval students and wise men of comparatively recent times.

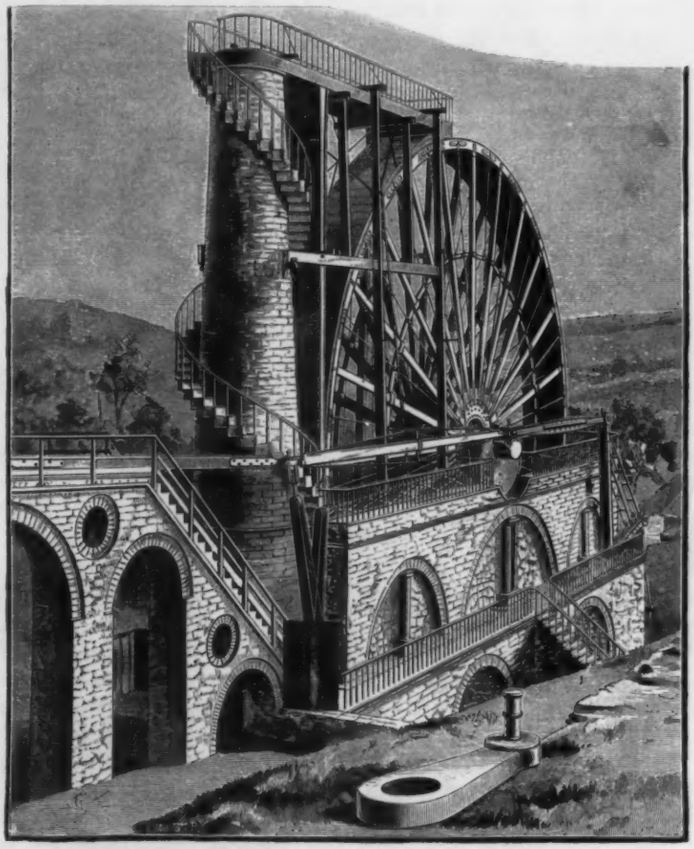


Fig. 6. Overshot Wheel, 72 ft. 6 in. Diam.; 150 H.P.

And yet how real did the present at that time seem! How readily did Isis seem to speak from the animated statue actuated by a series of water buckets, cords, and levers, constructed by priestly cunning to give divine support to their temple teachings. How sacred was the river Nile and all its creatures—and justly may it have so been held—for was it not the father of all good in their land—was not the Egyptian civilization the direct result of this clustering of peoples around its beautiful banks, and indeed. to pursue the thought further, do we not find the rise and fall of Greece and even her legendary history, coincident with her exploits—from the fall of Troy and the quest of the Golden Fleece down to the birth of Rome? And Rome! Was not she the ancient mistress of the world, nurtured in her youth, maturity and age by "Father Tiber?" And were not the prosperous cities of medieval Europe dependent on their resources of water transportation? Did not Venice, Queen of the Adriatic, rise to a position pre-eminent among the nations through her favorable maratime location? Spain and latterly England in more recent

times, have joined the long vista of nations who owe the history of their national superiority to the facilities which water has bestowed upon thus favored mankind.

And so, as a direct contributor to the advancement of national supremacy and creation of our modern civilization, water is found to have been an agent of the greatest importance and service to man. But this may be considered as a digression as it has but little reference to its use as an agent for the development of kinetic energy in its physical sense, however important a potential factor it may have been.

Its employment as a means of developing useful power, probably dates back also to the dark ages, almost beyond the dawn of civilization. For water wheels are claimed by the Chinese 1000 B.C., although the period was one when human energy was by far the cheapest and the most universally employed agent, even less valuable than the work of oxen. Slave labor was ready at the bidding and in almost unlimited amount, to serve the whims and vanities as well as the conquests of ancient monarchs, as the ruins of Babylon, the Pyramids of Egypt, and the great Chinese Wall bear mute testimony. With this almost unlimited supply of human labor, what use had they for the power of falling water? Yet we find as mentioned above, the inventive genius of the priests making use of it in several very ingenious ways, such as animated statues and water clocks.

Some of the earliest uses of current wheels were to raise water for irrigation and stock watering, and many ancient canals and conduits show a general familiarity with its simple natural laws. But its general development lay dormant until such later time as man shirked his early bondage and harnessed for his needs and comforts, this God-given source of inexhaustible energy.

The first considerable uses to which water power was put were naturally those connected with agricultural pursuits, for agricultural lands were naturally situated along the banks of rivers or canals, and therefore what more natural than current wheels for such power as was useful for the husbandry of the day, and the raising of a little water to a little higher elevation to make a little more land productive. The question of efficiency, if considered at all, was most remote. An old current wheel would be rudely put together to turn the chain of buckets, and do the work for which the oxen or slaves had formerly been employed. This was not in the service of the monarch, or for that matter, any slave holder, but rather for the very poor man who had neither slaves nor oxen, and to whom necessity was veritably the mother and father of invention.

This current wheel then found its way to rapids and water falls, and we have the germ of the undershot wheel. As time runs on, and human labor began to have some value, we find the overshot type used some distance away from the stream, where power was wanted for grinding corn or other primitive work, the water being led to it through masonry conduits or flumes, thus giving a considerable power in a more useful location, and in many instances, confronting man with an amount of power almost beyond his needs, and in most cases, far more than any crude machine could then advantageously use. Subsequently, therefore, inventive effort was concentrated for centuries on the improvement and enlargement of machinery for the use of this "Frankenstein," before the question of efficiency became important.

Some early forms of wheels however came into quite extensive use. The old English Doomsday Book mentions several hundred then in use in England at the time of the Norman Conquest, almost all for grinding corn, and although these must have been very crude devices, they certainly served well the requirements of the time.

Great must have been the effect on mankind of this discovery of water power, secondary only to that of ships, and wagon wheels. So great a source of power, and so susceptible was it to give much more than his most extravagant needs required, that we find the question of efficiency again one of no moment.

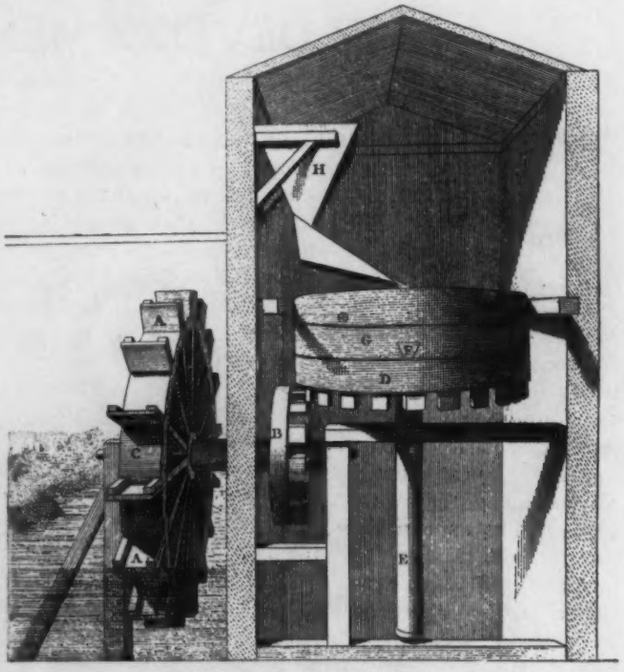


Fig. 1. Early Form of Current Wheel to Grind Corn. Vitruvius, Rome 14 B. C.

Probably one of the earliest recorded adaptations of the current wheel for industrial use, is that of Vitruvius and illustrated in Fig. 1, where the power developed is used to turn the mill stones, the grain being fed in from the hopper "H."

Showing distinctive lines of thought, may be contrasted the impact wheel in Fig. 2, also of very early but unknown origin, and not at all unlike the general arrangement of the jet and buckets of the modern steam or gas turbine.

The overshot wheel was well understood by the middle of the eighteenth century, some really scientific thought having been given to the various factors tending to get the most power for the least cost of construction. The names of Euler and of Borda are linked with particularly clear thought on the subject of eliminating the losses of impact and discharge velocity. Euler was a Swiss mathematician 1707-1783, Borda a French mathematician and astronomer 1733-1799. Euler studied the mathematics of the flow of water over curved surfaces and indicates forms of

guide and runner surfaces for improving efficiencies not unlike those found in wheels built at the present time, and which principles are in fact of fundamental value. See Fig. 3.

In the late eighteenth century we find some of the mills in France driven by wheels provided with spoon shaped buckets—the wheels being mounted on vertical shafts to fascilitate the connections with the

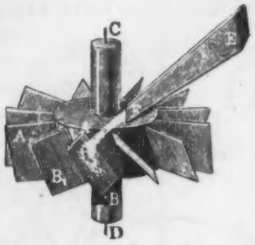


Fig. 2. Early Form of Impact Wheel.

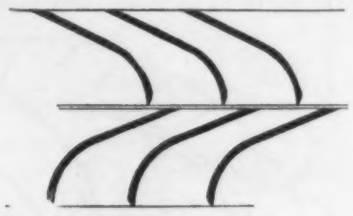


Fig. 3. Shapes of Guide and Runner Vanes to Avoid Entry Losses. (Euler, 1754.)

mill stones and avoid the troublesome gearing (Fig 4). These show quite clearly the result of Euler's teachings and an understanding of the necessity of eliminating any shock or disturbance to the entering water and the effort to minimize the velocity of discharge.

The wheel shown in Fig. 5 in which the water enters the curved blades substantially tangential and leaves after giving up most of its energy (if the wheel velocity is properly proportioned to the velocity of the

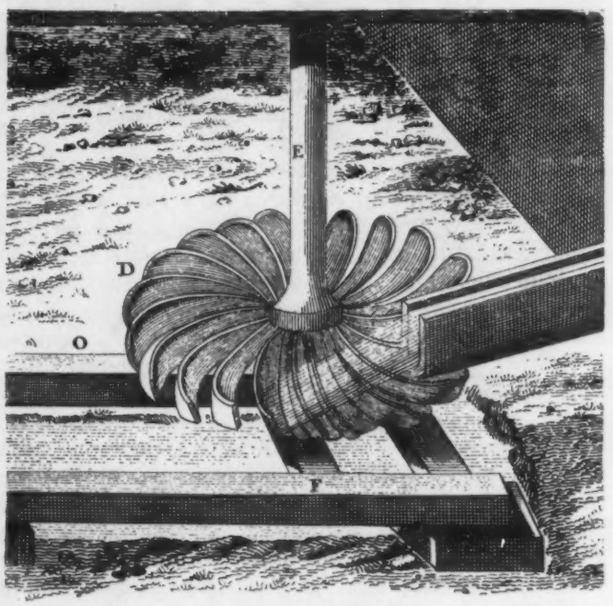


Fig. 4. Impulse Wheel Fitted With Spoon-Shaped Buckets (Mills in France, late Eighteenth Century.)

entering water) indicates a very clear understanding in the early part of the nineteenth century of the value of proper bucket or vane curvature and is a more careful elaboration of the principles embodied in the wheel of Fig. 4.

This type of wheel, Fig. 5, with its especially ingenius gate mechanism, received real commercial adaptation, and gives us one of the earliest indications of the modern turbine. It is the natural result of a demand for more power and the multiplying of the number of nozzles until water entered around the entire circumference, the water thus having a whirlpool appearance. The "whirl-pool" action in a turbine was thus derived synthetically and not analytically from observation of whirl-pools in rivers.

It is quite natural that as the demand for power in larger units grew more acute, we should find a tendency to generate more from the then known wheels, and what more natural than that of increasing the water issuing against the runner blades by utilizing the entire periphery of the wheel to receive its impulsive action. And so the art progresses to the gen-

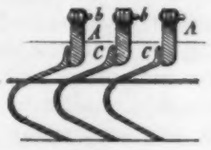


Fig. 5. Curved Bucket Impulse Turbine With Slide Gates. (Early Nineteenth Century.)

eric forms of that class of water wheel most generally spoken of today as "turbines"—this being that class which employs pressure or pressure and impulse around most or all of the circumference of the runner as distinguished from overshot, undershot, impulse and tangential wheels.

A good example of the overshot is shown in Fig. 6, showing one of these wheels in use for many years at the tin mines on the Isle of Man.

In this case the wheel is 72 ft. 6 in. in diameter,

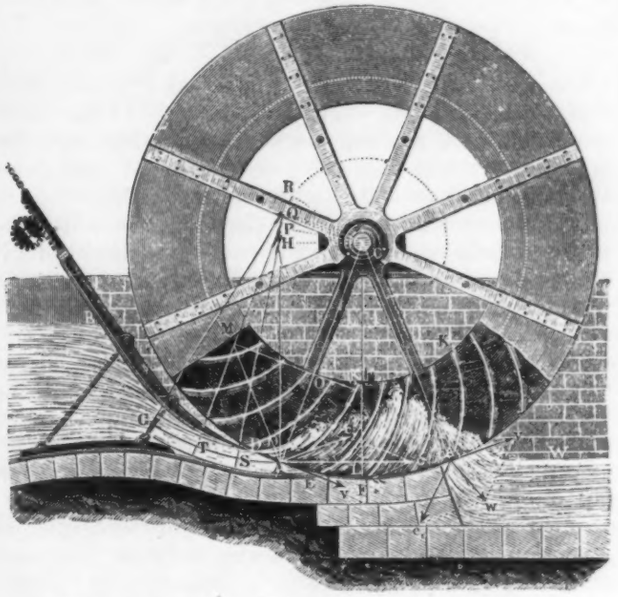


Fig. 7. Poncelet Undershot Wheel (Weisbach-DuBois.)

which is of course the working head or pressure it employed and developed 150 h.p. at a painfully slow speed. The masonry conduit employed to bring the water many miles combined with the cost of the wheel made the first cost per unit of power developed something enormous.

The writer saw a 50 ft. diameter overshot wheel in Mexico in 1896 on which it was said the freight from Vera Cruz (before the railroad was put in) amounted to over $100,000, which wheel was shortly afterward replaced by the introduction of electric

power, needless to say at a great saving in operating cost as the water then became available under a higher head.

The undershot wheel was brought to a very successful design by Poncelet. See Fig. 7.

Here it will be seen that the water energy is largely converted into velocity and received on curved surfaces where after its velocity is given up to the blades of the wheel it discharges by the action of gravity—the efficiency over earlier current wheels was increased quite 50 per cent by this method and quite an efficient gate or controlling device was employed.

The name "turbine" seems to have first been applied in France to any water motor or wheel when revolved in a horizontal plane and on a vertical axis (their first considerable use having been for driving mill stones). The first one really scientifically built was that of Fourneyron who received a prize from the Societe d'Encouragmente for his improvements. The

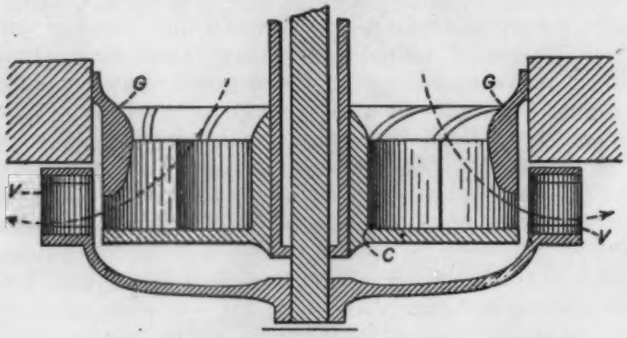


Fig. 8. Cross Section of Fourneyron Turbine (Morin.)

word "turbine" has come however to have a much more restricted meaning on account of the tangential or impulse wheel now being differentiated from pressure and pressure and reaction wheels.

Impulse or action turbines are those in which the entire kinetic energy in the water at the time it enters the runner is expressed in terms of velocity, whereas pressure or reaction turbines are those where the potential energy is not entirely converted into velocity before entry. It will be noticed that in the former the water passages need not be filled with the flowing water and in the latter case they must be so filled to avoid losses. In the former case partial admission is usual, in the latter, complete annular admission is always found.

No truer example is to be found in the history of invention, of its following in the wake of necessity, than the development of the turbine.

The Fourneyron turbine mentioned above attained quite extended use following its introduction in 1827. It is of the outward flow type, and is illustrated in Figs. 8 and 9.

The runner is mounted on a vertical shaft and carries a series of curved blades or buckets. Water enters through the fixed curve passages of the guide chamber "C" and through a continuation of these guides in the gate ring "G." The rotation of the gate ring admits more or less pressure water to the runner, thus providing regulation. Carefully designed wheels of this type are said to have given 80 per cent efficiency and it was well adapted to very much higher heads than had been formerly used. This outward flow Fourneyron turbine has been used until quite recently and probably its best known installation is at the No. 1 Plant of the Niagara Falls Power Company, see Fig. 10, where very satisfactory results were obtained. This plant was one of the pioneers in hydroelectric development and will receive further consideration later.

Coincident with the growth of commerce and therefore of factories, and machines for the production

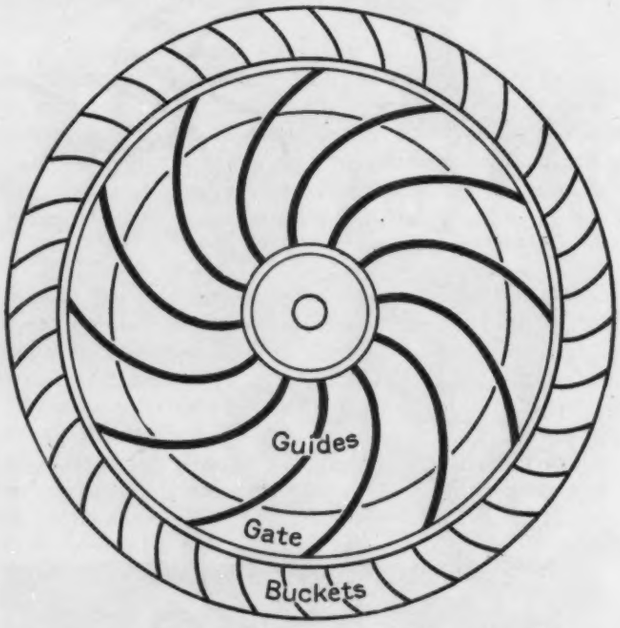


Fig. 9. Plan of Fourneyron Turbine Showing Guides, Gate and Buckets.

of fabricated products came the demand for power in larger quantities, and its value as a commodity. So factories grew at the points where water power was found available, and as the capital investments became heavier, and the product greater, the improvement in overshot and undershot wheels kept even pace with the demand for power in increasing quantities. Following this recurrence to the old forms of undershot wheels as improved by Poncelot, we find crude forms of turbines, first of the pressure and then the impulse type, and with them the adoption of higher speeds in driven machinery and the abandonment to a considerable degree, of the cumbersome and inefficient reduction gearing. Thus was the trail well blazed for the discovery and rapid development of the steam engine, finding as it did, a great field, with then practically no question of fuel values to handicap its adoption, and giving wonderful facility to factory location which might then be chosen with much greater freedom and with consideration of such other factors as market location, transportation facilities and such questions of great economic importance.

The development, however, of some water powers of favorable location still offered inducements of great value, and we find some of the towns of Massachusetts growing up to the limits of the power available in their mill streams, and with business increasing and no more power in sight, or at least, not without great additional development expense. In this dilemma, J.

B. Francis, in 1847, attacked the problem in truly scientific manner, making a careful analytical study of the entire question with but little of a reliable nature in the way of data or literature, and his Lowell hydraulic experiments are indeed now of a classic nature.

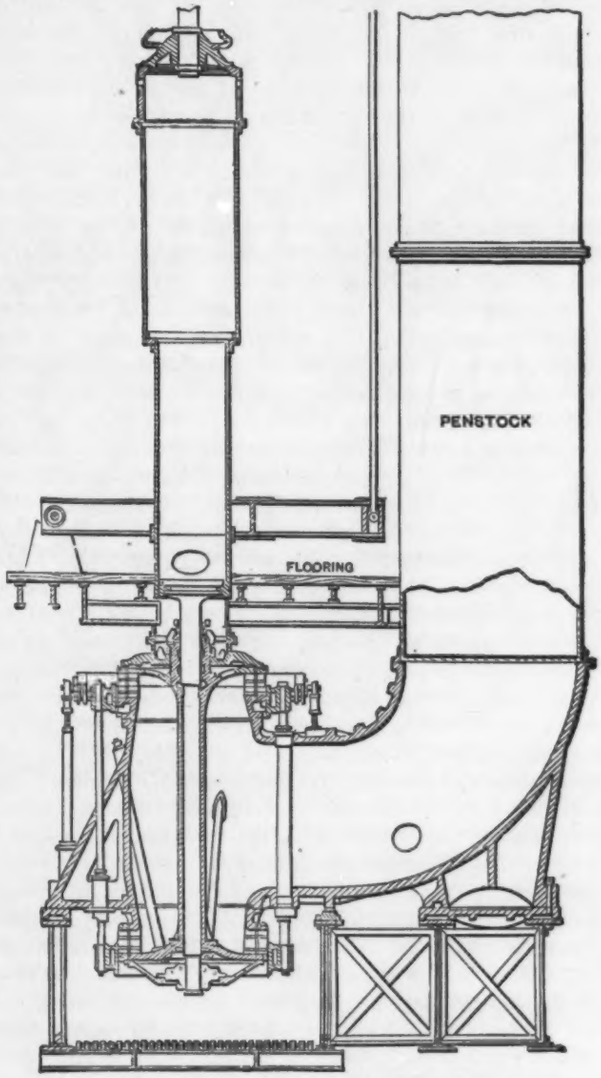


Fig. 10. Double Fourneyron Wheel, two runners being of greater and less diameter, water entering from underneath and above to secure hydraulic counterbalance for the weight of the revolving element. Each of the runners is divided into three sets of blades, thus making in reality six wheels on each shaft. Ten units of 5000 h.p. capacity under 136'-140' head are installed in the No. 1 power house of the Niagara Falls Power Co., New York.

The form of impulse and reaction wheel, today known to the world as the Francis turbine, and largely developed by him, still follows closely the results of his work. The United States had not then sufficiently grown as a manufacturing nation, nor was power so valuable as in some European countries whose scientists were quick to recognize its great value, and who, during several decades, have concentrated attention to the developing of this form of wheel, and its adaptation to commercial needs. The water powers of Switzerland, Northern Italy, Germany and Austria provided the drill ground for this recruit, and only within the last twenty years has the Francis turbine again come into its own in America. Indeed some of the earlier designers in this country avoided with unpardonable regularity, any profit of the really scientific work that had been done abroad, with the natural result that the banks of some streams are strewn with flotsam and jetsam of unnecessarily and often foolishly repeated experiments. This condition of things has also worked a hardship on the investor who now scrutinizes with cautious eye, the proposal to use turbine wheels for developing his water powers.

Without doubt, however, the finest turbines in the world, equal in efficiency to the best ever produced in Europe, and of the simplest rigid and safest construction, are now being designed and built in this country, together with the highest type of governing apparatus.

(To be continued.)

OPPORTUNITIES IN CENTRAL STATION MANAGEMENT.

BY C. W. KOINER.

In the course of an address to the students at the Throop Polytechnic Institute, Mr. Koiner who is the manager of the Pasadena (Cal.) municipal light plant, offered a number of interesting suggestions, from which the following has been taken:

A central station is managed as is any corporation, the power being vested in a board of directors. However, it usually falls to the lot of the general manager to carry out the policies of the company, and to be responsible and to represent the corporation in its activities. Sometimes this power is vested in one officer holding the dual position of president and general manager. In a great many instances, where properties are owned and controlled by banking institutions and syndicates, the officer in active charge of the property is usually the general manager.

Some of the necessary characteristics of a central station manager are, first character (a man should be well grounded in the fundamental principles of honorable dealing), ability, patience, tact, industry, courage, perseverance, common sense and technical training. These characteristics are required for a small plant as well as the large one. The manager who is in charge of a small plant has to meet the people face to face and is often brought into direct contact with his customers, whereas in the large central stations the general manager rarely meets his customers, unless it be an extremely large user.

In most instances the manager of a utility company, light, power, gas, railway, etc., usually is in charge of a monopoly. To manage a property of this character in a state in which there is no regulation by commission, is not a small task. The central station manager is supposed to represent his company in a creditable manner in the community in which he serves. Necessarily he should be qualified to represent and carry out the policy of his company in a way that will be satisfactory to his patrons as well as to his company.

In this connection, I do not believe any man should accept the management of a property unless he has absolute respect for the policy of the company. If the policy is such that he cannot carry it out without being ashamed of it, or being placed in a compromising position, he should not attempt the task. There

are a great many times when we will not agree entirely with the policy of a company; that is to say, we may have an opinion that a policy inaugurated or established could be so amended as to improve conditions, when the policy may be an honorable one, and may only be a matter of business. The only policy worth considering in handling and managing a central station properly, is to do business on business lines, free from all political entanglements, giving high class service at a reasonable price, returning to capital its just share in the enterprise, and giving to the customer a little bit more than he pays for, if need be, and at a rate that will always enable the company to discharge its just obligations to the community it serves and also to its employees.

I am in favor of a high standard for both salaries and wages, as well as a high standard of performance. It has been said that low wages, and I might add irregular employment, is responsible for more misery and poverty in this world than any other one thing, and I believe it.

The central station manager is facing the problem of how to sell more electrical energy along his lines. A very important department has been added in the conduct of the central station business, and is known as the "New Business Department." Just how much electrical energy can be used in a community, in other words the point of saturation, is unknown. With the lowering of the cost of electrical energy to the consuming public, the amount used is increasing at a rapid rate. As a general thing a household has a certain amount of money that will be spent for a particular service; a certain amount will be spent for electrical energy. With the lowering of rates for lights in the various communities, the household will immediately adopt electrical energy for other purposes. Heating devices, vacuum cleaners, small motors and the like, are attracting the attention and are being adopted by a large proportion of central station customers.

In some of our old eastern communities the number of houses using electrical energy varies from 30 to 50 per cent, depending upon the progressiveness of the companies serving the communities, while on the Pacific Coast the proportion (especially in Southern California) is at least 95 per cent of the houses along the lines. However, the companies in the East have been inaugurating the New Business Department, putting managers at the head of this department, who are in charge of all the solicitors and the campaign for securing new business. These campaigns have had a marked success, and it is remarkable to what extent the service can be extended, even in small communities. In fact some of the very best showings have been made in the small towns. One town in the State of Ohio, I think, had the record last year. Their annual income per capita was between $8 and $9. This was in a town of about 5000 population.

Therefore, you can readily understand that the opportunity for increasing the efficiency, for extending the business and for making improvements, setting a high standard of operation, etc., does not belong exclusively to the larger central stations. It frequently happens that some of the managers in the smaller companies set very high standards, and the larger companies, a great many times, learn valuable lessons even from the small central station manager. It is a good thing for a young and ambitious manager to remember one thing, and that is—that a man who can operate a small central station successfully can always get a larger one to manage.

A great many central stations are now owned by syndicates, and the policy of management is directed from the parent office. I regret exceedingly that this is so. In some instances it is of course a great improvement over the old method, where local owners did not really understand the central station business, nor would they employ a manager who did understand the business. Of course it is a great improvement to have these stations operated by the parent office, which understands the management and operation of such properties. However, on the other hand a plant that is not owned and controlled by a syndicate can be operated by a high class manager at less expense and in a more efficient manner than is the case with a great many syndicate owned properties. The reason is, with the syndicate owned property the overhead expenses overbalance the gain that would reasonably be expected by consolidating a number of properties and operating them by one head.

Some of the reasons for the high overhead cost are that the promotors, those who are engaged in making a big hit in selling securities, usually organize an operating company, whose officers have to be compensated by large profits, together with the usual construction company organized for taking more profit; and the purchasing, of course, is done for all of the properties and sometimes an additional charge is made on the purchasing and charges made to the constituent companies. In one case with which I am familiar, some of the local companies did not remit their earnings over and above their operating expenses, and interest on investment, that is the surplus which was used as working capital, and the parent company charged their constituent companies interest on the unremitted balance. Of course, under State regulation this would not be approved, because the primary reason for so doing was to make the cost of operation look higher to the local community that the company served.

I am of the opinion that companies can grow too large for efficient management. I believe that where a company does not have a monopoly, it could not stand the competition of a well managed competitor. I am speaking now of the extremely large corporations, and especially of properties owned and controlled by holding companies. It would be an easy matter to go into any city of 25,000 population or more, and install a competing plant, under local management, that would be first-class and give a rate that would be lower than any syndicate owned property could possibly give, and pay interest on the investment charged against the plant, and pay its other overhead charges. After analyzing the difference between the plant controlled and operated by the syndicate, and the plant owned and operated by local management, I find that the results obtained by local management, when in the hands of good managers, excel the results obtained by other methods of management.

The American public is prone to fall down and make obeisance to large aggregations, or seemingly

large aggregations of capital. In other words, when we mention a large concern the public gives up before they consider, and feel that they would not be able to compete. I am of the opinion that the larger the corporation, unless they are given a monopoly, the easier the competition. This remark does not necessarily apply to all central stations or to electric stations of large capacity, neither is the remark confined to central stations only.

An ex-manager of one of the largest firms of this country, recently remarked that no corporation could compete with the individually managed property, or co-partnership company, when all of the real owners were on the job.

The young engineer, and the young man who is preparing himself for a responsible position on the managerial staff, whether it be of central stations or industrial enterprise, must not take too much for granted, but must satisfy himself of the truth of the conditions and the fundamental principles involved in his line of work. It will be found that the place offering the greatest opportunity for improvement will be with the large corporation, which includes municipalities, and public works of State and Nation. That is to say, the efficiency can be considerably increased, and as the independent companies spring up, whether central stations or industrial, the large companies will be in search of young men and engineers who can point out the weak places and increase the efficiency, for which they will be willing to pay handsome salaries to those who can get results.

The electric central stations absorb ten thousand men every year.

It is not a very hard problem to manage a very large concern that has a monopoly of the business it conducts. There can be great waste without detection. However, when this concern is brought into competition with a rival that operates its property in an efficient manner, cutting out the waste, and bringing up the efficiency, then it is that such a company's mismanagement will show.

A great many concerns invite competition by maintaining a rate that is entirely too high. This warning was given by Mr. Edison in the early days, in fact at the time he formed the first central station, by calling attention to the fact that when the rates were too high it invited competition at once.

Hence the future offers great rewards to the young man who is properly trained, and one who is vitally interested in the work and who will specialize and take the branch for which he is suited.

Referring to the old adage "There is always room at the top," this, of course, has always been true and is true today more than at any other time in the history of the world. Mr. Edison claims there are more ten thousand dollar positions than there are ten thousand dollar men to fill them.

There is a good opportunity for those who will take the time and pains to learn the central station business. Even if we cannot attain to some of the highest positions in some of the largest companies, municipalities, States or Nation, it may be possible for us to take the highest position in some of the smaller companies, or it may be possible for us to hold some responsible position in some of the larger companies.

As you court responsibility, so your position will be a higher and better one. The high salaries require responsibility. Central stations today need men who know the business and who are willing to give the necessary time to learn the business from the smallest detail up to that of the largest duty in connection with the business.

I do not believe the work of learning the business, or any business for that matter, is as hard on the young man, as the worry that he will encounter if he does not learn the business, when he gets into a responsible position. Work does not hurt us but worry does.

The habits formed in the early part of our career are sure to stick to us. And in this connection, we should be very careful not to hinder our progress by acquiring habits that will be a detriment after we progress to the point where we expect promotion, we should be prepared for it.

That which will benefit young men most today is the practice of the homely virtues. These are overlooked by a great many young men who spend four years or more in college, and when they seek employment put in jeopardy their prospects by bad manners at the time they are applying for a position. They will walk into the office of a prospective employer with a cigarette or cigar in their mouth and their hat on their head, and with an attitude that would give one the impression that the business could not exist unless they were engaged immediately.

This characteristic applies to a great many young sales engineers. It militates against their progress. Some do not realize that it does, but if they were in possession of the true facts they would realize that it did hinder their progress.

There is a time and place for all things, and the time for a young man to put forth his best efforts is when he is endeavoring to make an impression seeking advancement and seeking to sell what he has acquired by four or five years of hard study, to the concern that will pay him for the exercise or use of his brains.

A UNIQUE FINE SYSTEM.

A source of saving to the city of Walla Walla, Wash., little known to the general public is the fine or refund charged the electric light company for every light found out at night during the year, which during 1911 netted the city in the neighborhood of $150, by a rough estimate. This amount is credited to the city by the Pacific Power & Light Company in collecting its regular light bill. The system by which this sum is obtained is that whenever a patrolman finds a light off when it should be burning he notifies police headquarters, where a small record book is kept. About 400 lights were reported out during the past year, and for each one of these the city receives 33½ cents, so that the police department more than pays for the small amount of work necessary to keep the record.

The most northerly wire on the American continent is the newly completed telegraph line which the Canadian Government has constructed to Dunvegan, Alberta, on the Peace River extension.

SMALL ELECTRIC PUMPING PLANTS.

Owing to climatic conditions, an artificial means of applying water to growing crops is essential to the highest agricultural development in practically every section of the West. Under careful application, irrigation has thus brought forth results on western lands unsurpassed in the world. The Pacific Gas & Electric Company supplying power largely to the great interior valleys of central California, has collected much valuable data on small electric pumping installations. Such information is of much value to all those interested in supplying power to agricultural districts.

Irrigation by pumping with electricity offers more advantages than any other system of irrigation. It has been thoroughly tried and proven successful in every instance. In many districts where ditch water is available pumping plants are being installed because of the convenience and reliability of electric irrigation. Wherever electric power is available for pumping the general prosperity of the irrigators is high, and crop failures are unknown.

First cost for each acre put under irrigation is, on most land, cheaper than buying ditch rights. The plant can be located to deliver water at the most favorable point, thus reducing in many instances cost of checking and ditching. The expense of sinking wells is not great, while the pits and buildings required are simple in construction. The pumping and electrical equipment is of the simplest and most reliable. All material for a 5 in. plant should not cost more than $800. A plant of this size will, in most soils, irrigate 40 acres of alfalfa or orchard.

Cost of operation will compare favorably with any other method of pumping. No attendant is required. The water is delivered at the time it is wanted, avoiding long waits, as is sometimes necessary with ditch irrigation. The quantity of water can easily be regulated by the irrigator. The cost of power is not excessive and is accurately measured by meters that can be easily read by any one. In this way a careful check can be kept on the cost of water.

The type of pumping plant most generally installed is a centrifugal pump direct connected to an electric motor and set in a pit near the water level. Centrifugal pumps are built in two styles, vertical and horizontal, each meeting certain conditions. A good centrifugal pump will draw water as far as a plunger pump, or about 28 ft. However, it will operate with much less power when set near the water level. For this reason pits are usually dug with the floor at or near the level of the water in the well when the pump is not running. These pits may be lined with concrete or boarded with redwood. The pit is covered by a house, frequently built with a wood frame and with sides and roof of corrugated iron.

The base or bedplate of the pump and motor should be held firmly to the floor by bolts imbedded in the concrete or timber foundation. In digging the pit enough room should be allowed to permit easy access to every part of the pump and motor. A substantial stairway or ladder should lead down in the pit from the ground level. An electric light should be hung in the pit and low enough to light every part of the pump and motor. A beam, carried by studding in the house frame, should be over the pit. This should be strong enough, and carried by studding equally strong, that a pulley and rope may be used for lifting out pipe, valves or parts of the pump that may need inspection or repairs. To prime the pump a small pitcher or suction pump is usually connected to the top of the pump case or suction elbow. Its connection and method of operation depends on the use of a foot or check valve for keeping the pump full of water when not running.

An important feature in drilling a well is developing the water supply. When the perforated casing is landed in the water-bearing strata, or the casing punctured, whichever method is used, it is important that the largest reservoir possible be formed in the water zones. This is done by pumping out the sand and gravel around the pipe. If done carefully, a large saucer-shaped cavity, with the casing passing through its center, is formed. If not carefully done, the upper strata may cave and greatly reduce ,or entirely prevent, the water flow. Where a well has been properly developed it will make but little sand afterward, thus reducing wear on the pump and making sand pumping unnecessary. This work of devolepment is usually part of the well drilling contract. Insist that it be done properly and not slighted or hurried in an effort to get to the next job.

The pit should be large enough when finished to allow at least two feet between any of the machinery and the wall. At one side of the pump enough space should be allowed to remove either pump or motor from the base. In some ground the side walls of the pit will stand without bracing during the excavation. In such ground it is best to dig the pit large enough that the back forms used in pouring the concrete can be removed. When back filled and tamped a better-looking job will result. Where the ground will not stand, it is a good plan to place the bracing in such a manner that it serves for one side of the forms. When the pit is completed this side of the forms will be left in the ground.

All the cement manufacturers issue booklets describing different concrete mixtures and methods of pouring as well as form building. Use a mixture that will make a water-tight wall. To insure an absolute water-tight pit, a finishing coat should be put on. After the forms are removed, carefully clean the walls and floor. Then wet thoroughly and apply three coats, each one-eighth inch thick, consisting of one part cement, one-tenth part water slaked lime, and one part sand. In choosing your sand for concrete mixing, select clean, sharp sand, free from pebbles and surface soil. Be sure your cement is fresh and perfectly dry when you buy it. If it must be stored, put it in a dry, well-ventilated, room. Cement can be stored for an indefinite length of time in a dry place, but a small amount of moisture in the air will rapidly reduce its strength. If gravel is used for mixing concrete, better results will be obtained by screening into uniform sizes. Crushed rock is preferable for water-tight concrete walls.

Circular pits are rapidly coming into favor, as they allow better access to machinery and are more easily excavated and made water-tight. Where the well casing passes through the floor, a screen should be placed around the suction pipe to prevent any thing

from dropping in the well. Where cement or concrete construction is too expensive, redwood planking can be used for walling the pits.

The Electrical Equipment.

Where the wires enter the pump house, clay tubes should be set in the wall at an angle to keep the rain from entering. Outside a "drip kink" should be made. Just inside the building a switchboard should be set up. This may be a slate panel on a pipe frame, or a plank nailed to the wall for mounting the meters and other devices. Between these two extremes many different arrangements may be had. Convenience for reading the meters and controlling the pump are the principal things to consider when locating this board.

First in the electric circuit the fuses will be found. These are strips of metal buried in powder and enclosed in a fibre tube. A heavy or dangerous load on the motor will cause enough heat from the electric current to melt these strips of metal. The powder in which they are buried is a special compound that quickly kills the spark caused by breaking the electric circuit. The fuses are the safety valve, guarding your plant from danger.

Next in the electric circuit are the meters used for measuring the amount of power consumed. The meters are supplied by the power company.

The next device in the electric circuit is the switch for starting and stopping the motor. The best switch for this purpose is enclosed in an oil-filled tank. This is quite expensive, however, and most irrigators use what is known as a triple-pole single-throw knife switch.

Following the switch is the compensator or starting box. Throwing full voltage on the motor when it is standing still would cause damage. The compensator cuts down the voltage to a safe point until the motor is running at nearly full speed. The full voltage is then thrown on by moving the starting lever to the running position. The more improved types of compensators have included a device known as a no-voltage release. This serves to protect the motor from many electrical accidents and should always be used.

The wires from the compensator to the motor may be carried in pipes or conduit. This is the best method. In many plants, however, the wires are carried on insulators and brackets fastened to the walls of the pit. In putting these wires and devices in place, care must be taken that all joints and connections are well soldered, then wrapped with a pure rubber splicing gum and a second wrapping of insulating tape then applied. A good coat of insulating paint is the best finish. Failure to observe these precautions will result in serious losses of power and possible danger from life and to life. Be sure this work is done right.

In buying a motor, select some well-known make that is not an experiment. There are several well-known manufacturers that supply reliable motors, and it is advisable to buy from them. Motors are now rated rather close by the manufacturers. If twelve horsepower is needed for a pump, buy a fifteen horsepower motor instead of the ten horsepower machine some salesmen may contend is large enough. It is generally more satisfactory to have the local electrical contractor put in the electrical work than bring a contractor from the city, as any defects can be brought to his attention more strongly. Money spent in buying good electrical material and time spent in seeing that it is carefully put in place, will be amply repaid in lower cost for power.

Factors to Consider in Choosing Pumps.

A centrifugal pump consists of a rapidly revolving runner or wheel turning inside a casing. The water is led into the vanes, corresponding to the spokes, at the hub and is thrown outward by centrifugal force. This runner has no rim or tire and the water is thrown into the collection chamber cast in the casing, and surrounding the runner. From here it is carried in suitable piping to the point of use. It is self-evident that the faster the runner revolves, the greater the force with which the water leaves the pump. Likewise, the smoother the sides of the water passages and the fewer turns made in passing through the pump, the less power will be taken up by friction.

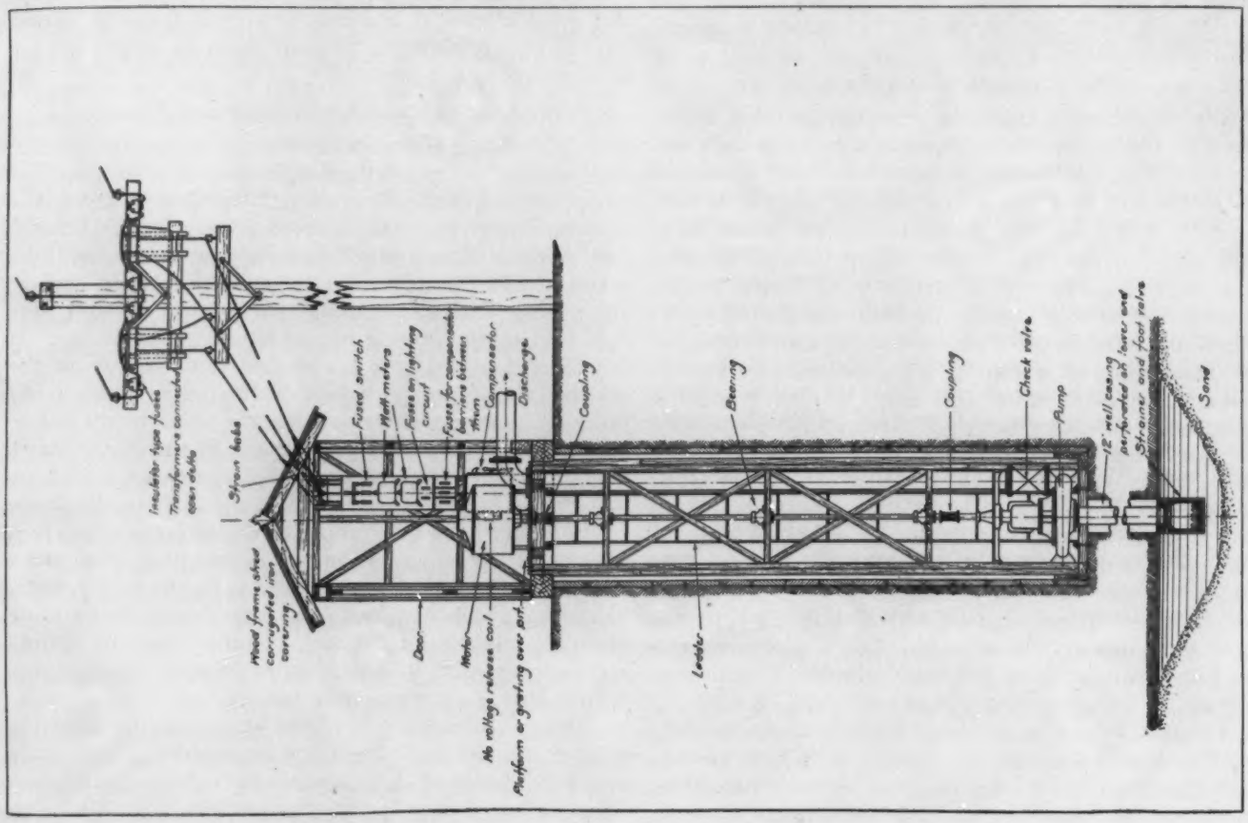
Proper sizes of runner and casing and correct shape of the vanes have everything to do with the efficiency, or amount of power required. The best way to be sure of getting an efficient pump is to buy of a reputable firm, which has had long experience in building pumping machinery. Their designers are, or should be, familiar with the proper relation of runner and casing that gives thhe best results.

Many salesmen put undue stress on the question of open runner and closed runner pumps. Both when properly designed and made are efficient machines. Their relative merits are comparable with the Percheron horses of one farmer and the Belgian horses of his neighbor.

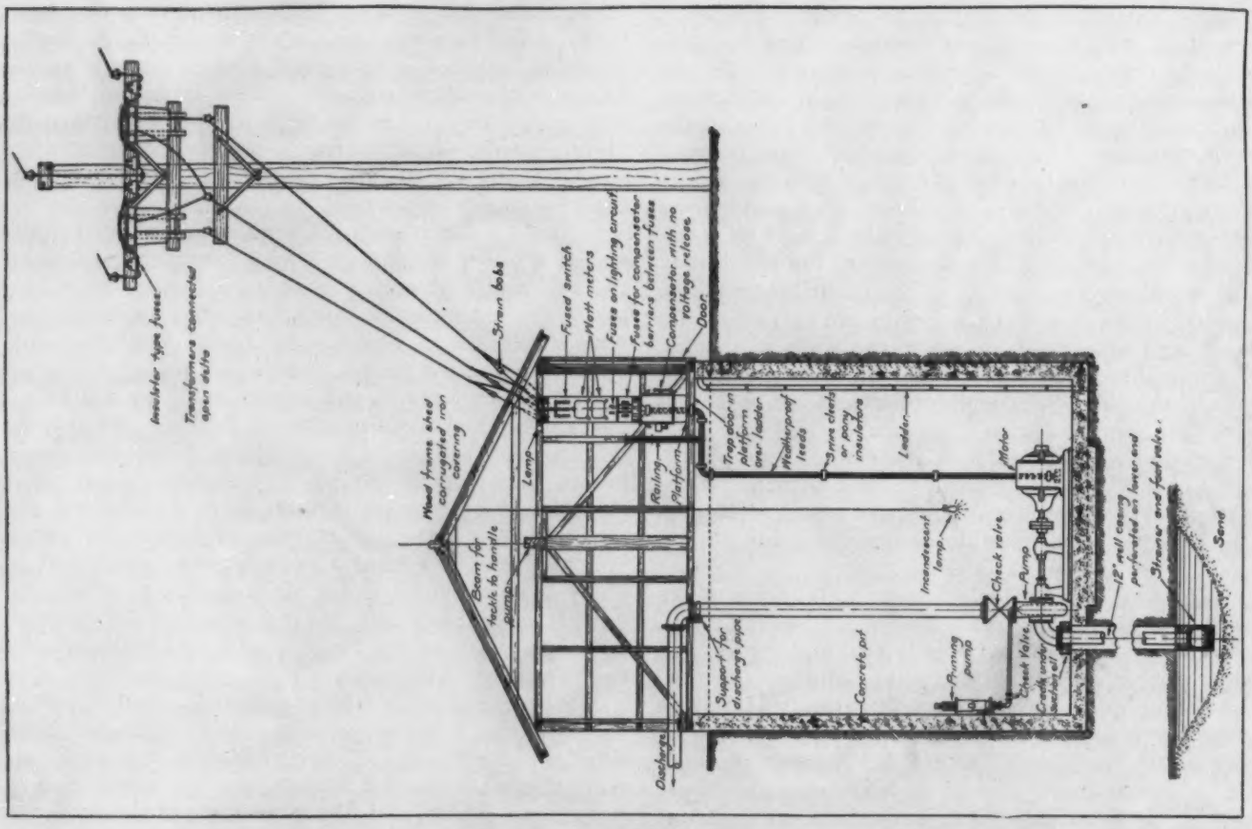
It is well to have an efficiency clause in the contract, and a final payment large enough to protect you if the pump does not come up to contract. After the pump is installed it is a good plan to have it tested by an independent engineer. This is not an expensive proceeding. The meter installed to determine your monthly bill accurately measures the power consumed, while the quantity of water pumped and total head are easily measured.

Avoid a pump with many complicated water passages. Be sure the shaft is strong enough to withstand the belt pull. Be sure it is in perfect mechanical balance. Do not accept a pump that vibrates when running at full speed. This is particularly imperative with a direct-connected pump. There is a strong tendency in the pump runner to pull to one side. This is called end thrust, and a pump that is designed to remove this thrust is said to be hydraulically balanced. Some pumps have special devices, operated by water pressure, for this purpose. Others have a collar on the shaft to absorb the thrust. Be sure that the pump you buy does not have a complicated device that is likely to get out of order, or a device that will be quickly cut out by sand. This is also true of the rings put on the sides of the runner to prevent leakage back to the suction side.

Wherever possible buy a direct-connected pump. The first cost is not materially greater when you consider the extra cost of belting, foundations, and belt way. Direct-connected pumps take less power to operate them, for at least fifteen per cent of the power is consumed in the belt. In many cases a new belt is required each year, no small item of expense. It is



Details of Vertical Pump Installation.



Details of Horizontal Pump Installation.

important that the manufacturer know the exact height the water is to be pumped before your order is placed, as direct-connected pumps are always made to order. This also means that a little longer time will be required for delivery. Buying from a reputable concern is even more important in this instance.

To sum the whole matter up, get a simple pump without any fancy automatic devices, with strong bearings and a shaft of ample size, and with its weight well distributed. And then buy from firms who are experienced pumping machinery builders.

Installation of Horizontal Pumps.

Many purchasers have the work of installing included in the contract price for the pump. In many instances money would be saved by the purchaser doing his own installation, with the aid of the local electrical contractor, as the manufacturer must protect himself against loss of time and fluctuations in the price of material. The manufacturers furnish a template, a wooden frame for suspending the foundation bolts. Before the cement floor is laid, set this template so that the foundation bolts will come in the proper place. To provide for slight errors it is a good plan to slip a short piece of pipe somewhat larger than the bolts, over them. When the concrete is poured the foundation bolts will be held in proper position to receive the pump base.

For lowering the pump into the pit, a gallows frame used for dressing beef will serve if the pump is not larger than five-inch. For larger pumps a stronger frame should be made. Be sure the ropes and tackle used are in good condition. When the pump is on its foundation, level it by thin wooden wedges and run a thin grout of one part cement, one part sand and enough water to make it pour, under the base. When this sets, draw the foundation bolt nuts up tight all around and the pump is ready for piping.

Use flanged piping on both suction and discharge. Be sure the pipe flanges that bolt to the pump flanges are properly drilled. The suction piping should always be standard piping, preferably galvanized. Power will be saved by using both suction and discharge pipes one size larger than the pump openings. Use flared fittings for connecting pipe and pump. The suction pipe must not be supported from the suction elbow A cradle should be built over the well, and the flange on the end of the suction pipe may rest on this cradle

Use a good quality of gasket in all flanges. A slight leak will greatly increase power consumption. To keep the pump full of water when shut down a short time, a check valve of some sort must be installed. If the total head pumped against is less than forty feet, a foot valve may be used. If the head is greater than forty feet a check valve must be put in the discharge pipe. Most foot valves have a strainer casing, but where a check valve is used a strainer should be put on the end of the suction pipe.

As a centrifugal pump will not throw water until the casing is full of water, or, in other words, will not prime itself, some means must be provided for doing this. A small hand pump is usually installed for this work. If a foot valve is used, priming may be done by pouring water down the discharge pipe. If a check valve is installed, a priming pump must be used. The proper place to connect a priming pump is at the highest part of the pump casing. One of the most common faults in starting a pump is becoming "air bound." Be sure every bit of air can be pumped out of the casing and suction pipe by the priming pump.

Double-riveted steel pipe, either galvanized or coated with asphaltum, is suitable for discharge pipe if the total head to point of discharge does not exceed eighty feet. Above this head, standard pipe will give better service. Always use flanged and bolted joints.

An elbow should be put on the discharge pipe and the pipe extended outside the building. Where the discharge enters the water box through the bottom, water is constantly splashing over and may cause burnouts in the motor. Do not discharge the water against the side of the ditch. Build the water box so that the water is guided into the ditch in the direction of flow.

Installation of Vertical Pumps.

Vertical pumps are usually installed where the ground water is so far below the surface that the expense of sinking a pit for a horizontal pump would be prohibitive. Instead of a pit, a shaft large enough to pass the pump is sunk and the pump installed at the bottom with the motor at the surface. A timber frame work is built in the bottom of the pit and a vertical frame extends from top to bottom, carrying pump and shafting. At the top a frame is built to carry pulley or vertical motor. Spreader bars should be spaced every ten feet on the vertical frame. Vertical bearings are attached to these for keeping the shaft in line. Great care must be taken that this shaft is kept in perfect alignment.

The frame work is usually put together on the surface; pump, shafting and bearings put in place and every part accurately fitted. It is then taken apart and lowered into the pit in sections. In the better grades of vertical pumps the stuffing boxes and bearings are inclosed so that submergence does not injure them. It is then possible to install the pump below water level, thus doing away with priming pumps. The weight of the suction pipe can be carried by the pump if attached to the bottom, but if it terminates in an elbow and is carried into the upper part of the pump, it must be supported separately.

The discharge pipe should be carried up one side or in a corner of the pit and not be attached to the pump frame at any point. If the total head exceeds forty feet a check valve must be used. For lower heads a foot valve is suitable. It is a good plan to use suction and discharge pipes one size larger than the pump openings. A flared reducing fitting should be used to keep friction losses low.

The ladder for reaching the bottom of the pit must be clear of the pump frame, yet so placed that all of the vertical bearings can be reached from it. No projecting set screws should be allowed on the shaft. It may become necessary to go to the bottom of the pit while the pump is running and a projecting set screw would be dangerous. If a belted pump is used, the cradle carrying the pulley must be well braced against the belt pull. Where a vertical motor is installed, the frame work supporting the motor must be rigid to prevent undue vibration. As a vertical pump requires considerable mechanical skill to install, it is best to employ a competent mechanic. Even with a highly effi-

cient pump, slight errors in aligning the shaft will result in serious losses of power.

Care must must be taken to keep the vertical bearings carefully oiled. Some manufacturers provide an elaborate system of oil pipes running to the surface. While handy, these are liable to become clogged or damaged. The best method is a good ladder from which every bearing can be reached.

Operating Hints.

Always use a good grade of oil in the bearings. This applies to both pump and motor. Poor oil causes excessive friction losses and frequently causes the soft metal bearing-lining to melt. Keep the cups full and when ring oiling bearings are furnished be sure the rings turn properly. Even a slight kink will keep these rings from turning so care must be exercised to keep them in condition. Keep the stuffing box packed with a good grade of packing. Do not experiment. The wear of revolving shafts is the most severe wear that can be imposed on packing. If you have a grade of packing that is giving satisfaction do not be lead off by the cheapness of another grade, for the material and workmanship entering into the manufacture of packing are expensive and few packings on the market are suitable for centrifugal pumps.

Many pumps are now being made with water sealed stuffing boxes; that is, with a chamber cast about the gland and kept full of water while pumping. This effectually prevents air entering the pump casing, but the seal must be carefully watched that the water is not drawn in.

Be careful to keep all joints in the suction pipe absolutely tight. The slightest leak rapidly increases the power consumption. Keep your well free from sand. If much sand shows when pumping it is advisable to shut down your irrigating plant and sand pump your well. Before the irrigation season opens you should test your well and sand pump it if necessary.

The above suggestions are general, as the pump manufacturers change their designs so frequently that instructions applying to a pump this season may not apply the next. Get complete instructions regarding special devices at the time you buy your pump.

Regarding the electrical equipment the only rules to follow are: to keep oil in the bearings and to keep the motor and switch dry and clean. Do not throw the switch from starting to running position too quickly. If these precautions are followed the electrical equipment will never get out of order.

Below is given a table showing the average capacities of centrifugal pumps. Some manufacturers increase the capacity of their pumps by using a larger size suction, others try to overrate their pumps by casting large suctions on a certain casing and calling the resulting pump the next size larger.

Size.	Diam. Discharge.	Diam. Suction.	G. P.M.	Sec. Ft. and Acre Inch Per Hr.	H.P. Per Ft. Lift.
1	1	1	25	.056	.02
1½	1½	1½	70	.156	.045
2	2	2	120	.27	.06
3	3	3	230	.518	.11
4	4	4	420	.945	.21
5	5	5	700	1.57	.35
6	6	6	950	2.14	.44
7	7	7	1200	2.7	.55
8	8	8	1600	3.6	.75
10	10	10	3000	6.75	1.4
12	12	12	4000	9.00	1.8

TESTS ON INSULATOR PINS FROM CALIFORNIA EUCALYPTS.

A great deal of attention has recently been focused on the planting and growing of eucalypts in California. Many companies have been organized, much capital has been invested, and the large acreage already planted is being rapidly increased. The Forest Service has sought to aid eucalyptus growers by publishing such information concerning the tree and its uses as it could secure after careful study, and in circular 179 of the Forest Service may be found much valuable data.

The eucalyptus is a native of Australia and the adjacent islands, where some 150 varieties are found. It was introduced in California in 1856, when it was planted around San Francisco Bay for ornamental purposes. During the next few years it was planted in the Santa Clara Valley for wind-breaks. Since 1865 the eucalypts have been extensively planted in California, mainly for wind-break purposes around orchards and vineyards, and also for fuel. The extensive planting operations of the past four or five years have been taken up with the idea of furnishing not only fuel, but also telegraph poles, piling, and lumber large enough to make vehicle and carriage stock and furniture material.

About 75 species of eucalypts have been grown in California. The blue gum was the first species introduced into the State, and has been much more extensively planted than the others. Probably 90 per cent of the eucalyptus in California at the present time is blue gum. Of the many other species introduced, red gum, sugar gum, gray gum and manna gum make up by far the greater part. These five give indications of being well adapted to California conditions, although, of course, others may be found which will give just as satisfactory results.

As a rule, blue gum grows erect; it branches low in isolated specimens, but in close plantings the crowns are small and the lower trunks fairly clean. It reaches its greatest development along the coast and in river bottoms where foggy days are common and the annual rainfall is at least 15 inches. The species when grown under favorable conditions ranks among the fastest growing trees of the world. The wood is yellowish white and easily polished.

A combination of the results of the tests on green blue gum gives, in the bending tests, an average fiber stress at the elastic limit of 6907 pounds per square inch; an average modulus of rupture of 11,800 pounds per square inch; an average modulus of elasticity of 1,788,000 pounds per square inch; and an average elastic resilience (shock-resisting ability) of 1.58 inch-pounds per cubic inch. The average crushing strength parallel to grain is 4919 pounds per square inch; the average strength perpendicular to the grain at the elastic limit is 1329 pounds per square inch; and the average shearing strength 1625 pounds per square inch. In the air-dry material the strength is increased except in compression perpendicular to the grain.

In a series of tests on hickory, now under way

by the Forest Service, the average modulus of rupture of several kinds in a green condition, including pignut, shagbark, mockernut, big shellbark, nutmeg, and water hickory, runs from 9200 pounds per square inch for nutmeg hickory, which is considered an inferior variety, to 11,450 pounds per square inch for pignut. For comparison with these figures, blue gum has an average modulus of rupture for green material of 11,800 pounds per square inch, or slightly larger than for pignut hickory. The dry weight per cubic foot of blue gum is about 49 pounds. The average weight of oven-dry pignut hickory is about 51 pounds per cubic foot.

Let us next analyze the results of tests on the four eucalypts, red gum, sugar gum, gray gum and manna gum. Green sugar gum has strength values considerably above the other species. It has an average bending strength of 16,480 pounds per square inch and an average crushing strength of 7215 pounds per square inch. Red gum comes next in strength, with an average modulus of rupture of 12,570 pounds per square inch and an average crushing strength of 6047 pounds per square inch. Manna gum shows the lowest strength values of the four species. Gray gum occupies an intermediate position in regard to strength.

Enough has been done to indicate that some species of eucalypts grown in California may prove excellent substitutes for woods in use at present for cord wood, piling, posts, poles, cross-ties, mine timbers, paving blocks, insulator pins, furniture, finish, veneer, cooperage, vehicle stock, and tool handles.

The value of eucalyptus, particularly blue gum, for insulator pins, has been thoroughly demonstrated. Eucalyptus pins have been used extensively in California and have been shipped to Canada and the Eastern States. After fifteen years' service, sound pins are still in use.

In April, 1909, arrangements were made by the Forest Service with the Pacific Telephone & Telegraph Company to have eight eucalyptus globulus and eight tanbark oak cross-arms placed in the company's lines in San Francisco. They were originally 8-pin arms, but when set in the line only six pins were used, the two pin holes nearest the pole, upon either side, being left vacant. None of these arms were painted, although the standard arms were at that time protected in this way. The company does not now paint its standard arms. The arms were equipped with eucalyptus and tanbark oak pins, except in the case of one arm, in which standard pins were set. Both arms and pins were cut from planks which were air-seasoned at the Berkeley Laboratory for almost two years. The arms were manufactured at the laboratory and the pins at San Jose. The experimental material was set in the line on September 8, 1909.

The pins were inspected Nov. 7, 1911, and the following conclusions were drawn: The non-insulated tanbark oak pins were found in fair shape, but those of the non-insulated eucalyptus pins were in better condition. The insulated eucalyptus pins were found to be in excellent condition and in better shape than the others inspected, while the standard oak pins, both insulated and non-insulated, were in poor condition.

ENTROPY CHARTS AND THE STEAM TABLE.[1]

BY ROBERT SIBLEY.

Those who are accustomed to speak of indicated horsepower from the reciprocating engine at once wonder if it is possibe to obtain an indicator card from the turbine. Of course, a moment's thought will show that it is impossible to take an indicator card from a steam turbine because the fundamental operation of the mechanism is of such a nature as to preclude cards of this sort. It is possible, however, to draw an indicator card of the particular turbine in operation when we know the pressure, temperature and moisture relationship of the steam throughout its expansion.

In discussing the comparative rating of a reciprocating with a steam turbine unit, the comparison at once brings up a discussion of the particular standard to be used. The standards that seem to have become firmly imbedded in modern practice are cumbersome and, without careful thought and additional computation, indicate only approximate comparisons.

Thus, a reciprocating engine is said to require 21 pounds of steam per horsepower hour, while the particular steam turbine may require but 15 pounds of steam per kilowatt-hour and yet under certain extreme conditions the reciprocating engine may have better efficiency. The pressure, temperature and quality of the steam are important factors in computing the efficiency, for after all, it is not the actual amount of steam required per horsepower-hour or per kilowatt-hour, but rather the number of heat units necessitated in the operation of each unit of power. Speaking in general terms the following are given by Professor Ennis in his recent treatise on thermodynamics as the best results that have been obtained under ordinary working conditions.

SATURATED STEAM.

Type of Engine.	Best Steam Rate. 1 HP.	Average Steam Rate. 1 HP.
Simple, Non-Condensing	21.5	38.0
Compound, Non-Condensing	19.14	23.0
Simple, Condensing	16.5	22.0
Compound, Condensing	11.22	18.0
Triple, Condensing	11.05	....
Quadruple, Condensing	(169.29 B.t.u.)	....
	B.HP.	
Single Stage Velocity Turbine	15.17	....
Pressure Turbine	13.08	....

SUPERHEATED STEAM.

	I.HP.	
Compound, Condensing	8.99 (192 B.t u.)	....
	B.HP.	
Single Stage Velocity Turbine	13.94	....
Pressure Turbine	Approximately	
Multi-Stage Velocity Turbine	10	....

Since the above have no real meaning unless reduced to equal pressures and temperatures of admission and exhaust steam, it would then seem desirable to make actual heat unit computations in each particular case. When this is done, an absolute standard of comparison is obtained. Let us, then, see if we can construct the chart, which, by the way, is used in place of the indicator diagram in the operation of the steam turbine and is also becoming popular for reciprocating unit comparisons.

It will be recalled that in previous lectures we discussed at much length the usefulness of a quantity

[1]This paper comprises the Twenty-first Lecture of a series of articles appearing in these columns entitled "Primer of Applied Thermodynamics."

known as entropy. We did not dwell upon the physical meaning of this quantity but contented ourselves with explaining it as such a quantity when plotted as abscissas with ordinates as temperatures, the area enclosed represents the heat necessary to bring the gas to the state shown at any particular temperature and pressure.

In Fig. 1 let us suppose we have a pound of water, which is at 32 degrees F. Let us call the point B on this diagram a point of zero entropy and 32 degrees F. in temperature. By referring to Peabody's Steam Tables or those of Marks & Davis, let us now plot, to the right, entropy and temperature conditions for this water during the application of heat. The water will finally be heated to a temperature, let us say, of 373.1 degrees F. At this point, which is D on the diagram, let us suppose that the water is under a pressure of 180 pounds absolute. Hence the water is just on the point of vaporization.

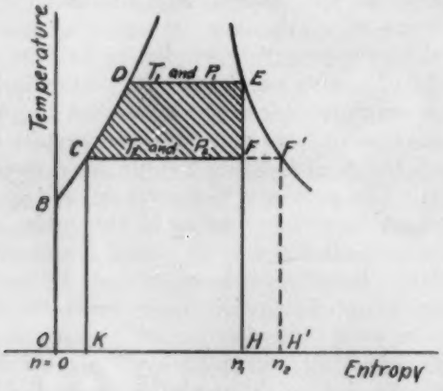


Fig. 1. Indicator Diagram for Turbine with Dry Steam.

If now we continue to apply heat, the temperature will not increase. The entropy, however, will continue in increasing values to the right, consequently the straight line DE represents our curve under these conditions, until finally the point E is reached when all of the water becomes evaporated into steam.

Should we now connect up all of the points of saturation on this diagram, the curve EF' would be the result. The combination of curves BD and EF' is known as the "steam dome." If the steam in our steam turbine or in the reciprocating engine expands adiabatically and at the same time iso-entropically we will finally arrive at the point F vertically below E. This point represents the condition of the steam in the condenser and is plotted to represent that temperature. At that temperature the steam is now condensed into water which is returned to the hot well. The entropy in the water under condensation decreases to C, so as to make an enclosed figure or cycle of operations as shown in the area CDEF. This cycle of operations is known as the Rankine or Clausius cycle and to this ideal cycle is referred the operation of all reciprocating and steam turbine operations. This of course can never be realized in practice but it is always used as a basis of comparison when speaking of the absolute efficiency of either the steam turbine or the steam engine.

By computing the area CDEF, we obtain at once the heat units in every pound of steam which have gone toward useful work. The ratio of the area CDEF to the area KCDEH will give us the ideal efficiency beyond which it is absolutely impossible to ever improve turbine economy.

Looking at these areas, let us see if we can derive some simple formula by which we can compute them without the use of a planimeter. The total heat of the steam at 373.1 degrees F. or 180 lb. abs. pressure is represented by the area OBDEH, which let us call H_1. On the other hand the total heat represented by saturated steam at the temperature of 101.8 degrees or one pound absolute pressure is represented by OBCF' H', which let us call H_2. The area of HFF' H' is seen at a glance to be $(n_2 - n_1)\ T_2$, in which n_1 is the entropy of saturated steam at the higher pressure and n_2 at the lower. The energy E, which has gone toward useful work, and which is represented in the

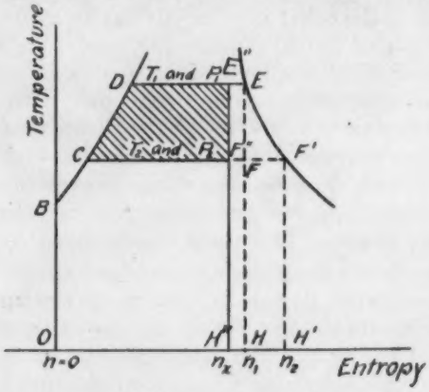


Fig. 2. Indicator Diagram for Turbine With Wet Steam.

area CDEF is equal to the sum of the areas OBDEH and HFF' H', less the area OBCF' H'. Hence we have the energy $E = H_1 - H_2 + (n_2 - n_1)\ T_2 \ldots\ldots (1)$

In a similar manner let us look for an instant at Fig. 2. Here we have represented a condition in which the steam does not become entirely dry, but arrives at the point E" having x proportions or parts steam, the remainder being suspended moisture. Under these conditions the useful work that has been performed is represented by the area CDE" F". It is evident that this area is equal to the area OBDE" H" plus the area H" F" F' H', less the area OBCF' H'. Hence, assuming n_x is the entropy of the steam at E", we have that the useful energy E is represented by the equation

$E - H_1 - H_2 + (n_2 - n_1)T_2 - (n_1 - n_x)\ (T_1 - T_2)$ or

$$E = H_1 - H_2 + (n_2 - n_1)\ T_2 - \frac{L_1}{T_1}\ (1 - x_1)\ (T_1 - T_2) \ldots (2)$$

Now let us consider the case in which the steam is superheated. Under these conditions Fig. 3 represents a fair idea of such a resulting diagram. By an identical and similar process to that above the energy E is

$E = H_1 - H_2 + C_{pm}\ (T_s - T_1) + (n_2 - n_s)\ T_2 \ldots\ldots (3)$

Let us now take an example and follow the calculations involved in the above three cases, wet, dry and superheated steam. A steam turbine receives its supply at 180 lb. abs. pressure, exhausting the same into the condenser maintaining a pressure of 1.0 lb absolute. Compute the best efficiency beyond which improvement can never be looked for.

Referring to Marks and Davis steam tables, we find the following data:

$p_1 = 180$, $b_1 = 345.6$, $L_1 = 850.8$, $H_1 = 1196.4$, $n_1 = 1.5543$
$T_1 = 373.1 + 459.6 = 832.7$, $p_2 = 1$, $h_2 = 69.8$, $L_2 = 1034.6$
$H_2 = 1104.4$, $n_2 = 1.9754$, $T_2 = 101.8 + 459.6 = 561.4$,
steam superheated 100° F., $c_{pm}\ (T_s - T_1) = 57.9$, $n_s = 1.6201$.

Case I. Let us assume that the entering steam is dry. Substituting in equation (1) we have

$$E = H_s - H_2 + (n_2 - n_1)\ T_2$$
$$= 1196.4 - 1104.4 + (1.9754 - 1.5543)\ 561.4$$
$$= 1196.4 - 1104.4 + 236.4 = 328.4 \text{ B.t.u.}$$

The total quantity of energy which has, however, been supplied to accomplish this 328.4 B.t.u. of useful work is

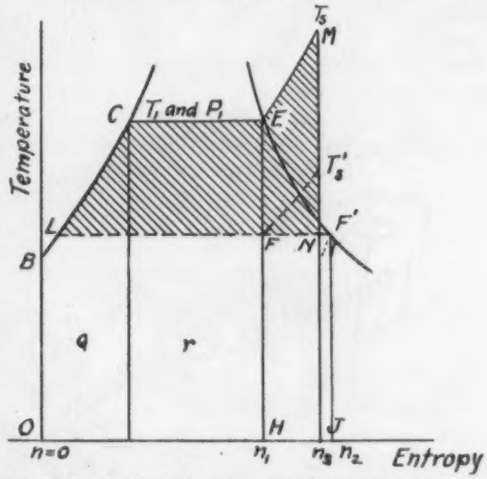


Fig. 3. Indicator Diagram for Turbine with Superheated Steam.

$$H_1 - h_2 = 1196.4 - 69.8 = 1126.6 \text{ B.t.u.}$$

Hence Rankine or Clausius efficiency $= \dfrac{328.4}{1126.6} = 29.16\%$

$$\text{Carnot efficiency} = \frac{T_1 - T_2}{T_1} = \frac{832.7 - 561.4}{832.7} = \frac{271.3}{832.7} = 32.56\%$$

Case II. Let us assume that the entering steam is 5% water. Substituting in equation (2) we have

$$E = H_1 - H_2 + (n_2 - n_1)\ T_2 - (n_1 - n_x)\ (T_1 - T_2)$$
$$= 1196.4 - 1104.4 + (1.9754 - 1.5543)\ 561.4$$
$$- \frac{850.8}{832.7}(1 - .95)\ (832.5 - 561.4).$$
$$= 1196.4 - 1104.4 + 236.4 - 13.8 = 314.6 \text{ B.t.u.}$$

Total heat supplied
$$= h_1 + xL_1 - h_2 = 345.6 + (.95 \times 850.6) - 69.8 = 1083.3 \text{ B.t.u.}$$

$$\therefore \text{Rankine or Clausius efficiency} = \frac{314.6}{1083.3} 29.05\%.$$

$$\text{Carnot efficiency} = \frac{T_1 - T_2}{T_1} = \frac{832.7 - 561.4}{832.7} = \frac{271.3}{832.7} = 32.56\%$$

Case III. Let us assume that the entering steam is superheated 100° F. Substituting in equation (3) we have

$$E = H_1 - H_2 + C_{pm}\ (T_s - T_1) - (n_2 n_s)\ T_2$$
$$= 1196.4 - 1104.4 + 57.9\ (1.9754 - 1.6201)\ 561.4$$
$$= 1196.4 - 1104.4 + 57.9 + 195.7 = 345.6 \text{ B.t.u.}$$

Total heat supplied $= h_1 + L_1 + C_{pm}\ (T_s - T_1) - h_2$
$= 345.6 - 850.6 + 57.9 - 69.8 = 1185.5$ B.t.u.

$$\therefore \text{Rankine or Clausius efficiency} = \frac{345.6}{1184.5} = 29.05\%.$$

$$\text{Carnot efficiency} = \frac{T_s - T_2}{T_s} = \frac{932.7 - 561.4}{932.7} = 39.8\%.$$

It is thus seen that wet steam decreases the efficiency while superheated steam within certain limits increases the useful energy ratio. Although these amounts are apparently small it is well to bear in mind this fact deduced above. The student may try higher degrees of superheat and he will arrive at a point where its beneficial effect in increasing the efficiency is no longer felt.

By looking at these efficiencies, one melancholy fact stares us in the face, and that is, design a steam engine or turbine with ideal conditions and even then thermodynamic laws are such that less than one-third of the heat energy put in will ever be returned to us in useful work. The Carnot efficiency on the other hand rapidly increases with range of temperatures and it may be that invention in other lines will materially aid us in still further perfecting the heat engine so that this ghastly loss may not occur.

Thermotwisters.

1. A steam turbine operates under 200 lb. abs. pressure and .50 lb. abs. vacuum. Compute the Rankine and Carnot efficiencies when
   (a) entering steam is dry;
   (b) when entering steam has 10% moisture;
   (c) when 200° superheat is used.

GERMAN TELEPHONES.

Telephone lines in Germany are owned and operated by the Government. The telephone service belongs to the postoffice and the telephone lines are operated by the imperial postal authorities, except in Bavaria and Wurttemberg, which have maintained their separate postal services.

There were in 1908 (latest figures available) 33,441 cities and towns in the German Empire having telephone service. There is no minimum size limit below which localities are shut out from telephone service. Exchanges are put up whenever it appears desirable, without regard to the size of the town. New exchanges are not, however, installed within a radius of 3.1 miles of existing exchanges. There are no towns of importance which have not telephone connections.

The rapid growth of the German telephone service is shown by the fact that the total number of subscribers in the German Empire, including Bavaria and Wurttemberg, was 591,973 in 1905, and 1,040,849 in 1910. The number of conversations in 1905 was 1,207,446,753 and 1,664,662,521 in 1910. It will be observed that the number of subscribers has increased more rapidly than the number of conversations.

The subscription rate varies according to the number of subscribers. In towns having not over 50 subscribers the annual rate is $19.04. It increases gradually to $42.84 for cities having over 20,000 subscribers. The charge for the use of public pay stations is 2.4 cents for a conversation of three minutes. Long-distance tolls range from 4.8 cents for a distance of 15.5 miles or less, up to 48 cents for over 621 miles, for a three-minute conversation.

Telephone equipment is delivered by private firms. The principal German concerns manufacturing purely telephone equipment are located at Berlin, Hanover, Munich, Hamburg, Fuerstenberg, Osterode, etc. The electrical industry is one of Germany's greatest industries. Equipment varies in different exchanges. A great variety of switchboard systems are in use, depending on the needs of the exchanges.

PACIFIC COAST ELECTRICAL JOBBERS' CONVENTION AT DEL MONTE, FEB. 22-23-24. '12.

In convention assembled at Del Monte, the jobbers, the manufacturers, the ladies and visitors, what more was needed as a prelude to a glorious time. Sunshine and good-fellowship complete the picture.

Thursday was devoted entirely to golf, pool and other enjoyments until 8:30 p.m. when the first meeting was called to order. Friday morning while the jobbers were discussing co-operation, the manufacturers were enjoying themselves on the links, on the beautiful drives, at the beach and in the surf.

At 2:00 p.m. the first drive was made in the golf tournament for the Jobbers', Patten and Del Monte trophies. Excellent scores were made considering the high wind the players had to contend with. Mr. T. E. Burger with a net score of 84 won the cups, while R. D. Holabird had the honor of the lowest gross score, 83. The score in detail is given below.

The New Clubhouse.

Jobbers' Del Monte and Patton Trophy.

	Gross.	Handicap.	Net.
Averill, F. N.	123	27	96
Berry, W. S.	84	23	97
*Burger, T. E.	111	27	84
Carter, H. V.	113	3	110
Carter, C. H.	98	4	94
Dederick, C. R.	120	13	107
Elliott, A. H.	121	6	115
Goodwin, W. L.	96	13	109
Graham, N. W.	112	13	99
Hillis, C. C.	93	3	96
†Holabird, R. D.	83	15	98
Hall, C. B.	110	8	102

* Winner. † Low gross score.

After dinner an informal dance was held in the ball room while the regular porch climbers' contest was carried on in another part of the house until Saturday morning, when the contest for the manufacturers' trophy was played off. T. E. Bibbins was the winner of this cup with a net score of 81, H. E. Sanderson carrying off the honors of a gross score of 83.

Manufacturers.

	Gross.	H'dcap.	Net.
*Bibbins, T. E.	94	13	81
Demming, W. M.	107	12	95
Gregory, S. B.	110	12	98
Hall (P. & S.) C. B.	116	27	89
Oakes, R. F.	No returns.		
Poss, F. H.	110	13	97
†Sanderson, H. E.	83	0	83
Seaver, W. H.	122	27	95
Van Riper, H. T.	129	27	102
Young, Garnett	118	27	91
Strong, E. B.	121	27	94
Vandegrift, J. A.	174	27	147

*Winner. †Low gross score.

Following this match the jobbers played for the "Ever Ready" cup. This resulted in a tie between Messrs. Averill, Berry and Hillis with a net score of 91 and Mr. Wm. Goodwin low gross score of 88. In the finals C. C. Hillis won by one stroke over W. S. Berry.

Jobbers, Everready Cup.

	Gross.	H'dcap.	Net.
*Averill, F. N.	113	22	91
*Berry, W. S.	91	0	91
Burger, T. E.	125	18	107
Carter, H. V.	94	2	92
Carter, C. H.	111	3	108
Dederick, C. R.	116	15	101
Elliott, A. H.	110	0	110
†Goodwin, W. L.	88	5	93
Graham, N. W.	131	10	121
*Hillis, C. C.	101	10	91
Holabird, R. D.	89	5	94
Hartley	127	22	105
Hall, C. B.	121	15	106

* Tied for first, C. C. Hillis won the play off. † Low gross score.

The banquet was held at 7:30 Saturday evening, the ladies being invited. Who but H. R. Warner could have designed a more beautiful setting than that banquet table with a hollow square, the center filled with growing palms, ferns and leaf plants, the white

The Judges.

linen dotted with myriads of stemless violets and places set for sixty guests. T. E. Bibbins in his always happy manner presided as toastmaster. Mr. Roscoe Oaks well named "Ever Ready" was in evidence here as in all of the games, the ballroom, the Monte Carlo and in fact as J. A. Vandegrift most aptly put it "as busy as a one-armed paper hanger covering the ceiling and afflicted with the hives at the same time." Mr. Oakes presented each guest at the table a miniature "Ever Ready" flashlight. At a signal the lights were out and the banquet room in total darkness, it was but a few seconds when myriads of mazda fire-flies seemed to be surrounding the table. from this moment the fun began.

A most delicious repast was served, interspersed with short talks from Mr. J. A. Vandergrift, Mr. R. F. Oakes, who responded to the toast "Ladies"; Mr. A. S. Moody, "California"; R. D. Holabird, "The Goddess of Chance"; H. E. Sanderson, "The Manhood of Chance"; Messrs. W. M. Demming and F. H. Poss, "Golf and Reasons Why." Mr. C. C. Hillis gave a most able address on "Co-operation and Good-fellowship," and was followed by Mr. Thos. I. Stacey, secretary-treasurer of the Electric Appliance Company of Chicago. His talk was the hit of the evening and ended with a statement that as "I am somewhat rusty on the subject of golf and as this is a golf dinner I feel somewhat out of place, but if it were an automobile gathering I could perhaps give you some little advice as to how to start an automobile, gleaned

from sad experience, and if I may be allowed I will read a few rules that I have had printed that may be of value to some of you at least." The rules are as follows:

1. Remove sparkplug, empty carbureter—and crank the engine.

2. Sandpaper the flywheel, take off the commutator—and crank the engine.

3. Kick the pup, blow cigarette smoke in the priming cocks—and crank the engine.

4. Disconnect the speedometer, reverse the windshield, empty the gasoline tank—and crank the engine.

5. Repeat a verse from the Koran, tie a wet towel about the cylinders, take off the mud guards—and crank the engine.

6. Take the motor entirely apart, put it together with your fingers crossed, drop a quarter in the tank—and crank the engine.

7. Crank the engine suddenly, without doing anything else. This often surprises it into running.

8. Turn your coat inside out, oil the tail light, throw the gasoline strainer over your left shoulder, stuff a cushion in the flywheel—and crank the engine.

9. Put a gumdrop in the cylinder, roll up your cuffs, connect the batteries with your watch, take off your necktie, yell "Hell!" into the gasoline tank—and crank the engine.

Perfect

New Links

10. If your engine does not start with rule nine you have failed somewhere in carrying out the directions in the preceding rules and should begin again with rule one, proceeding as before, but more carefully.

Several golf cups were presented to the jobbers, including one by J. A. Vandergrift, a jobbers' and manufacturers' cup; T. E. Bibbins, a manufacturers' and jobbers' cup; Mr. W. H. Seaver, a free-for-all lowest gross score, to be played for at the meeting in May and the Journal of Electricity, Power and Gas presented a cup to be contested for by the ladies of both the jobbers and manufacturers and to belong to the lady who wins it twice in succession or three times in one year.

Following the banquet, the regular Saturday evening Del Monte hop was enjoyed by all.

The contestants in the pool tournament were: Messrs. Seaver, Goodwin, Halliday, Averill, Hall, Graham, Moody, Dederick, Berry, Burger, Fowden, Holabird, Vandegrift, Sanderson, Gregory and Mirk. The finals were between Messrs. Graham and Sanderson and won by Mr. Graham, 15-5.

The manufacturers were represented by F. H. Poss, Benjamin Electric Company, Chicago; T. E. Bibbins, General Electric Company, San Francisco; W. M. Demming, General Electric Company, San Francisco; Thos. I. Stacey, Electric Appliance Company, Chicago; W. H. Seaver, U. S. Steel Products Company; H. E. Sanderson, Bryant Electric Company; J. A. Vandegrift, Oakland Warehouse Company; J. B. Hall, Pass & Seymour Company; Roscoe Oakes, American Ever Ready Company; W. M. Murray, National Carbon Company, Cleveland; S. B. Gregory, Arrow Electric Company; A. S. Moody, General Electric Company, Portland; Garnett Young, Telephone Electric Equipment Company; E. B. Strong, Journal of Electricity, Power and Gas.

Members of the Electrical Supply Jobbers' Association of the Pacific Coast, who were present at Del Monte meeting were: F. N. Averill, Fobes Supply Company, Seattle, Wash.; W. S. Berry, Western Electric Company, San Francisco; T. E. Burger, Western Electric Company, Los Angeles; C. H. Carter, Pacific States Electric Company, Los Angeles; H. V. Carter, Pacific States Electric Company, Oakland, Cal.; Chas. Wiggin, Dunham, Carrigan & Hayden, San Francisco; C. R. Dederick, Dederick Electrical Supply Company, Portland, Ore.; Frank Fowden, Brooks Follis Electrical Company, San Francisco; Ross Gilson, Gilson Electrical Supply Company, Oakland, Cal.; W. L. Goodwin, Pacific States Electric Company, San Francisco; H. W. Graham, Holabird-Reynolds Company, Los Angeles; Ross Hartley, Pacific States Electric Company; Portland, Ore.; C. B. Hall, Illinois Electric Company, Pasadena, Cal.; C. C. Hillis, Electric Appliance Company, San Francisco; R. D. Holabird, Holabird-Reynolds Company, San Francisco; R. E. Kendrick, Kendrick Electric Company, Seattle, Wash.; F. N. Averill, Fobes Electrical Supply Company, Seattle, Wash. The newly elected officers are C. C. Hillis president; Albert H. Elliot, secretary, and C. R. Dederick, member executive committee.

CLEVELAND ELECTRICAL LEAGUE.

The success of the entertainment features of the National Electrical Jobbers' Convention at Cleveland, Ohio, in February was largely due to the energetic efforts of the Cleveland Electrical League, which also has the credit for inaugurating the People's Electrical Page. The program for the meeting had for its cover a miniature representation of this page, as did also a number of large posters with the Jovian insignia in colors. The paper napkins for the banquet were likewise adorned. At the Jovian rejuvination 62 new members were admitted, and all the jobbers were unanimous in agreeing that Cleveland's hospitality was most royal.

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Hydraulic Engineering

In the leading paper of this issue is found the beginning of a series of articles on hydraulic engineering by Geo. J. Henry, Jr. The name of Henry so thoroughly permeates hydraulic power plant installation and equipment it seems unnecessary to go into details in setting forth the experiences from which Mr. Henry has drawn his information for this series. Suffice it to say that scarcely an installation of the West, including the islands of the Pacific, has been accomplished without feeling his masterly stroke in the design of some part of its make-up.

Men of such vast experience, of necessity transmit their energies under such high tension as a rule, the profession at large is forced to acquire their ideas not from the lips of the hydraulic engineers themselves, but by visiting their performances of human accomplishment in the canyons, where they are silent but impressive monuments to the skill and energy of our day. Seldom do we have an opportunity of reading in their own words the inner expression which gave forth such accomplishments of constructive imagination.

Few men are better informed than Mr. Henry on the subject of the design, construction and installation of tangential and turbine water wheels, and none are better qualified through practical experience or power of expression to step this information down to the engineering fraternity.

Electrical Supply Jobbers' Meeting

The Good Book has long since informed man of the beautiful provision made in Nature for the satisfaction of every human want; for, in the Twenty-second Psalm, we read "My cup runneth over, I shall not want." The Electrical Supply Jobbers' Association at their recent Pacific Coast meeting at Del Monte have even gone one point beyond the Biblical provision by seeing to it that there shall be no scarcity of cups to take advantage of nature's generous offer.

Although the cups donated in this instance look toward the promotion of keener competition in their outing contests in the health-giving game of golf, the electrical jobbers are nevertheless, to be congratulated upon the part they are taking in boosting the electrical industry in general and co-operation and good-fellowship in particular. Their comradeship and good feeling toward each other are proverbial, and the promotion of such comradeship and good-feeling is what makes our electric profession today—a profession of energy, uplift and progress.

Patent Reform

Many prominent inventors, among them Thomas A. Edison, Peter Cooper Hewitt, and Ralph D. Mershon, have through their organiztion, the Investors' Guild, petitioned President Taft to take early action in securing patent reform.

The petition sets forth that although congress is constitutionally authorized "to promote the progress of science and useful arts by securing for limited times to inventors the exclusive right to their respective discoveries," the present protection afforded is, far from

secure. The petition proceeds further to state that the delay in securing a patent and the exclusive right granted is so often infringed; that modern centralization of industrial power tend to restrain inventors in their work as well as the sale of their patents; and that the inventor is discouraged in his work consequently the nation is suffering from apathy, resulting from this unfortunate combination.

The petition bearing the signature of such men can but bring forth the earnest consideration of the President and Congress. While it concludes by merely requesting an investigation of present methods without suggesting improvements, it is to be hoped careful thought will be given to details of improvement at the proper time, for much good or harm to our nation is likely to be the result in the proper nurturing or hindering of invention.

Tests of Eucalyptus Pin Insulators

The stupendous growth of the California eucalypts has long been the marvel of all, so great is its upward development and so deep its downward root extensions. Thousands of acres of California lands, not otherwise available, have thus within recent years been given their opportunity to bear a portion of the burdens in production for a great commonwealth.

Much study has been given by the government agricultural stations and the Forest Service in the collecting of reliable data on this recent industry. Recent experiments indicate that the eucalypts seem to have a higher tolerance for carbonate of soda than do many orchard trees, and hence are apparently not sensitive to very large amounts of the sulphates and of common salt if distributed through the upper soil, instead of being accumulated on the surface. But to the electrical man, the continued returns of thoroughly reliable data, indicating especially the superiority of eucalyptus insulator pins, are of intense interest.

Some years ago, the Forest Service collected data from these tests, which showed that a thirty-year-old blue gum is stronger than hickory, and that a fifteen-year-old sugar gum is nearly as strong as black hickory and 91 per cent as strong as second-growth hickory. This is a remarkable showing. More recent tests are even more forceful. Elsewhere in these columns will be found the results of a series of tests in which eucalyptus is plainly shown to be superior to hickory, especially when used in sizes suitable for the insulator pin. Tests are also given in which the eucalypts have been proved in every respect superior to tanbark oak pins.

The Forest Service has collected specimens of eucalyptus from Australia, whence came the California species. The wood is there considered not to be of mature quality until the age of sixty years has been reached. As yet, a growth of thirty years only is possible on the Coast. Since the tests made thus far have been upon fifteen-year and thirty-year specimens, as time goes on, we may look forward to obtaining favorable results in tests upon insulator pins. The growth of the eucalyptus insulator pin manufacture on the Coast is well deserved and should receive the thoughtful consideration of all those having use for the best that can be made. Recent large shipments to Canada and Alaska bear witness to the fact that good things are appreciated abroad as well as at home.

Electric Irrigation Plants

The barren West cries for water; without it, only a howling wilderness is possible, but with its proper application to western soils, no more productive lands throughout the world can be found. The great power companies of the Coast are not asleep in regard to the future possibilities of power consumption in the small pumping plants now being so generously installed in the great valleys of the West.

The electrically operated pump is a source of revenue to the power company and a joy forever to the farmer. In most of our productive valleys an abundance of water is found within 30 to 60 feet below the surface of the ground, and a properly installed electrically operated pump possesses many advantagts superior to any other known mechanism accomplishing the same end. The water is under the complete control of the land owner and he is not dependent in any sense upon his neighbors, for his supply stands ready to be applied at any instant, day or night. There are no boilers to explode, no gasoline tanks to catch fire, and above all, a perfect operation is possible without complicated parts to keep in constant repair. It is cheaper to install and costs less to operate, and this cost never fluctuates throughout the year. The complete equipment is easily started almost instantaneously, and, in the parlance of the up-to-date farmer, "it is on the job, day and night."

Above everything else, the electrically operated pumping plant makes the farm a more livable place. It lessens the so-called "continual round of pleasure" in performing the daily chores, for it brings power to the barn and with it the possibilities of delicate dishes for the invalid and a Sabbath day's rest for the housewife. A thousand comforts are added to the daily life on the farm. The house, the cooler, and the barns can be lighted at any moment in sudden emergencies. Lower insurance rates on the barn and house make security and economy possible to a higher degree. A cool breeze provided by an electric fan is ever ready for the hot summer day, while a gentle warmth for the chilly spring and autumn days is possible from the electric heater. The long winter evenings strengthen the family ties by making the home more enjoyable with the soft, pleasing yet clear steady light of the electric lamp.

The great power companies, realizing the possibility of aiding in the development of prosperity and happiness in agricultural communities, deserve much credit for their co-operative spirit along these lines. The data they have gathered for practical instructions in installations of electric pumping plants is invaluable. The Pacific Gas & Electric Company of Central California has amassed much of this kind of information. In this issue of the Journal will be found the compilation of these data.

The independence enjoyed by the farmer, when electrically operated pumps are installed can hardly be conceived, without comparing his new surroundings with the previous condition of servitude under which he labored before. An opportunity of power consumption of electrical horsepower by the millions is thus opened to the great power companies and happy homes by millions are thus made possible in every commonwealth of our western empire.

PERSONALS.

C. R. Dederick of Seattle visited San Francisco and Del Monte last week.

E. M. Sanderson of the firm of Sanderson & Porter, of New York, was at Seattle during the past week.

S. W. Russell, superintendent of the Northern Electric system at Sacramento, was a recent San Francisco visitor.

J. A. Vandegrift of the Oakland Warehouse Company, left for Los Angeles, via Del Monte on Thursday of last week.

George H. Battee, representing the Electric Agencies Company, has returned to San Francisco from a Northern trip.

C. B. Johnson, a construction engineer for the General Electric Company, was at San Francisco during the past week.

G. R. Murphy, manager of the storage battery department of Pierson, Roeding & Company, is at Seattle on a business trip.

T. S. Clark, of Bates & Clark, electric and hydraulic engineers, has returned to Seattle from a two months' Eastern trip.

C. Remschel, formerly manager of the American Electric Company at Seattle is at San Francisco where he desires to locate.

Frank C. Kelsey, consulting engineer, has been appointed engineer in charge of a municipal water system for Centralia, Wash.

M. G. Garhart, formerly with the Seattle office of the Western Electric Company, has been appointed city electrician at Tacoma, Wash.

Robert McGlynn, formerly engineer with the United Light & Power Company, has joined the Farnsworth Electrical Works, San Francisco.

C. H. Ray of Medford, Ore., is at San Francisco visiting with Frank H. Ray, who is one of the directors of the Great Western Power Company.

W. M. Murray of the National Carbon Company, Cleveland, Ohio, left Los Angeles last week on a visit to the jobbers' convention at Del Monte and is now at San Francisco.

George M. Turner, formerly superintendent for the Washington-Oregon Corporation, has been promoted to manager, with headquarters at Chehalis, Wash.

M. M. Martin, manager of the Humboldt Transit Company's electric street railway system at Eureka, has been spending a few days at San Francisco.

Arnold Pfau, hydraulic engineer, with the Allis-Chalmers Company's Milwaukee office, has returned to San Francisco, after visiting Seattle and intermediate points.

F. N. Averill of the Fobes Supply Company, Portland, was in San Francisco last week on his way to Portland from the East. He attended the Jobbers' Convention at Del Monte en route.

Frank E. Cronise, who was formerly connected with the new business department of the Pacific Gas and Electric Company, has joined the office force of N. W. Halsey & Co. at San Francisco.

A. S. Moody, sales manager of the Portland house of the General Electric Company, was a visitor in San Francisco last week, attended the Jobbers' Convention and returned to Portland Sunday evening.

Wallace W. Briggs, assistant sales manager of the Westinghouse Electric and Manufacturing Company, has just returned to San Francisco after spending nearly a month in Los Angeles and Southern territory in connection with his generator contracts for the Los Angeles aqueduct and other business.

J. B. Hall of Pass & Seymour, Solway, N. Y., is at San Francisco contemplating the establishment of headquarters for his company. Mr. Hall will have charge of the sales department of the entire West.

George I. Kinney, manager of the California department of the Fort Wayne Electric Works, has returned to San Francisco after making a business trip to Los Angeles accompanied by J. W. White of the sales department.

R. S. Buck, of Sanderson & Porter, arrived at San Francisco last Tuesday from New York via Los Angeles with his family. He will make his future headquarters at the San Francisco office of the firm and will reside at Berkeley.

Thos. I Stacey, secretary-treasurer of the Electric Appliance Company of Chicago, and wife, was a recent visitor in San Francisco and Del Monte on his return from the Hawaiian Islands. He left Sunday evening, February 25th for Chicago.

S. L. Napthaly has resigned as general manager of the Great Western Power Co. to take charge of the Oakland-Antioch Electric Railway. His duties have been assumed by vice-president A. W. Bullard until his successor is appointed.

William A. Doble, chief engineer of the Pelton Water Wheel Company, has returned from Los Angeles, where he spent some time on business connected with the large water wheels for the Los Angeles aqueduct, which are to be constructed at the Pelton Company's Pacific Coast factory.

A. C. Sprout, supervising engineer on the Klamath River development of the California & Oregon Power Company, is again on the work, after spending a week at his San Francisco office in connection with the plans for the generating plant. Sidney Sprout arrived at San Francisco from Siskiyou County during the past week to close contracts for the first 10,000 kw. hydroelectric unit of the above installation.

Jacob Furth, president of the Seattle Electric Company and chairman of the board of directors of the Seattle National Bank, has been elected president of the Puget Sound Traction, Light & Power Company, the $40,000,000 corporation, which is about to take over the properties in the Pacific Northwest managed by Stone & Webster. R. T. Laffin, district manager of Stone & Webster, has been elected vice-president of the company.

CALIFORNIA ELECTRICAL CONTRACTORS' NOTES.

The Power Committee of the California State Association of Electric Contractors held a meeting in Bakersfield Sunday, February 25. The following members were presented President J. C. Rendler, J. S. Reynolds, W. A. McNally, C. V. Schneider, L. Levy and Secretary W. S. Hanbridge. H. Miller and Seth Cohn were absent on account of sickness. A long session was held lasting from 8 a. m. until 8 p. m., the members stopping only for meals and a short recess to look over Bakersfield's new court house. The conditions existing were carefully gone over and many suggestions for improvement were forwarded to the National Electrical Contractors' Committee, who will meet a committee of the National Electric Light Association. In order to bring out the points that were being taken up, the committee held a debate lasting a couple of hours. Messrs. Rendler, the secretary and Hanbridge taking the central station side, and Messrs. Schneider, Reynolds and McNally the contractors' side. The subject was, "Resolved, that the central station is justified in selling lamps and appliances and doing wiring." It was a very spirited contest and both sides had their subjects well in hand, and it enabled the committee to see things very clearly. It was decided to let the whole committee be judges, and it was decided as follows: Resolved, That it is to the best interests of both electrical dealers and contractors and central stations to co-operate for the mutual benefit of all, and to hold regular meetings at which should be discussed the most practical and economical manner in which a maximum amount

of current can be sold to the consumer, thus developing the business of all and retaining a satisfied customer.

The State License Committee, consisting of Messrs. Rendler, Reynolds and Hanbridge, held a short session and decided to raise funds for the purpose of having a proper license law drawn up and presented to the next legislature.

The local contractors were invited to become members of the State organization, which they all accepted and President Rendler formed a new local called Kern County No. 15.

The members of the committe then left for home well satisfied with the meeting.

The business conditions in Bakersfield are reported by electrical contractors, are good. The new court house is about finished and now the gardeners are laying out the lawns. This building was wired by the Turner Company and the fixtures manufactured by the Thos. Day Company, both of San Francisco. It is entirely lighted by Mazda lamps and the rooms are all well lighted. F. Meyers of San Francisco is the architect.

TRADE NOTES.

The Western States Gas & Electric Company, through H. L. Jackman, the Humboldt County manager, has ordered a Curtis steam turbine from the General Electric Company, for early delivery. This will be installed at Eureka, so as to double the generating capacity of the station during the coming summer.

Ross Hartley of Portland and C. H. Carter of Los Angeles, branch managers of the Pacific States Electric Company, have been in San Francisco for the past week attending the managers' annual meeting. On Monday evening, February 26th, the annual sales managers' meeting and banquet was held at the Techau Tavern.

The Pacific Gas & Electric Company is installing in its Fern Avenue substation, San Francisco, a Type 43 Gould storage battery of 152 cells for emergency use on the Edison three-wire system. It measures six feet from the floor to the top of the tank. Each cell contains 43 plates. There are four motor-driven high-speed self-regulating end-cell switches. The capacity of the battery is 10,000 kilowatt minutes. A similar storage battery is held in reserve at Station I on Eighth street.

The first car equipments for the Oakland & Antioch Railway have arrived at Oakland. There are two Westinghouse Type H L multiple control, quadruple equipments, the motors being of 75 h.p. each. The combination cars about 55 feet in length, are being constructed by W. L. Holman & Son. A powerful electric locomotive with eight 42-inch driving wheels will be shipped from the Westinghouse works for this road about May 1. Direct current at 1200 volts will be used on the line.

It is announced that the Pelton Water Wheel Company will build for use at the Alaska Treadwell Gold Mining Company's new Nuggett Creek development a special Pelton tangential water wheel unit with a capacity of 1900 h.p. under 490 feet head at 300 r.p.m. A General Electric generator will be direct-connected to the wheel. This unit will be equipped with a special form of needle regulating nozzle actuated directly by the governor. It is also provided with an auxiliary relief nozzle mechanism so designed as to afford the highest degree of water economy. It is claimed that danger of water hammer under a rapidly fluctuating load is prevented.

THE JOVIANS.

H. E. Sanderson, the new Jovian Statesman for California, is preparing for an aggressive campaign. He has just received a new booklet entitled "The Answer," by Ell C. Bennett, Mercury, which explains just what Jovianism means. Mr. Sanderson will be pleased to mail the booklets to all who are interested and will send a request to him at 609 Mission street.

BOOK REVIEWS.

The Steam Engine and Turbine. A text book for engineering colleges. By Robert C. H. Heck, M.E., Professor of Mechanical Engineering, Rutger's College. Size 6x9 inches; 631 pages; 402 illustrations; durable cloth binding. Published by D. Van Nostrand Co., of New York, and for sale by the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price, $5.00.

Professor Heck has put into this treatise a masterly detail in steam engineering. The textbook idea and the purpose of class-room use have continuarily been kept in mind. Mechanical form and manner of working are illustrated by selected, typical examples of construction; rational theory is built up, from fundamental concepts to the fully-developed ideal steam engine; and actual performance is studied and compared with the ideal, an especial effort being made to set forth clearly and logically the empirical knowledge which must fill the gap between them. An excess of mathematics is avoided, preference being given largely to graphical methods. The numerical examples which appear throughout the work, emphasize the quantitative side of the subject, and suggest problems for class-room use. Steam tables appear in the rear of the volume. They are slightly different from those of Marks and Davis, but are founded on the same experimental data. The steam turbine is handled in a scholarly manner and the cross-references met with throughout the discussion is most helpful to the student.

The book is carefully compiled and is to be recommended to the earnest consideration of those desiring a treatise on steam engineering, especially for that portion of the subject that relates to the steam engine and turbine.

Electric Discharges, Waves and Impulses and Other Transients. By C. P. Steinmetz, A. M., Ph. D. Size 6x9 inches; 150 pages; 64 illustrations; cloth binding. Published by McGraw-Hill Book Co., of New York, and for sale by the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $2.00.

C. P. Steinmetz, past president of the American Institute of Electrical Engineers, needs no introductive bow to electrical men the world over. Mr. Steinmetz in the past years has enriched our mathematical knowledge in electrical phenomena beyond description in words. The predetermination of electric phenomena in steady flow of power is now about complete. Generators, motors, transforming devices, transmission and distribution conductors can, with relatively little difficulty, be calculated, and the phenomena occurring in them under normal conditions of operations, be correctly computed before their occurrence. Phenomena occurring, however, under abnormal voltages, currents and frequencies, though by no means infrequent, are nevertheless little understood as yet. In a masterly manner Mr. Steinmetz has previously set forth a systematic study of such phenomena in a work entitled "Theory and Calculation of Transient Electric Phenomena and Oscillations." The book just presented is a simple physical study of the more difficult head-splitting mathematical deductions derived in the previous publication. Students undertaking the study of transient phenomena will find it profitable and instructive to read the latest publication first.

Motors, Secondary Batteries, Measuring Instruments and Switchgear. Electrical installation manuals. By S. Kenneth Broadfoot, A. M. Inst. E. E. Size 4x6½ inches; 96 pages; illustrated; clear type; strong paper; durable cloth binding. Published by D. Van Nostrand Co., of New York, and for sale by Technical Book Shop, 106 Rialto Bldg., San Francisco. Price seventy-five cents.

In this little book the author in a clear, simple style sets forth in eighty-five paragraphs, the elements of motors, secondary batteries, measuring instruments and switchgear. The methods to be used in oiling, starting, operating and repairing the above described mechanisms are gone into from their very fundamentals. The hints on faults of motors, circuit breakers and fuses are of much practical value. The book is of convenient pocket size and should find a welcome place in the practical man's pocket.

INDUSTRIAL

A NEW LINE OF MOTOR STARTING RHEOSTATS.

The Electric Controller & Manufacturing Company, of Cleveland, Ohio, has recently placed on the market, a new line of starting rheostats for series, shunt or compound wound, direct current motors. The manufacturers claim the following important advantages for these rheostats:

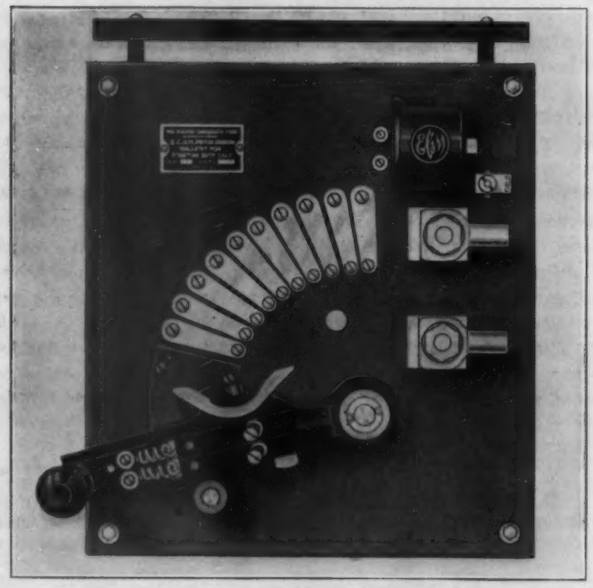


Fig. 1. New Type Starting Device.

The highest grade of Monson slate is used, having beveled edges and oil finish. On all sizes the contacts are removable from the front of the rheostate, without disassembling or interfering in any way with the wiring or resistance. The retaining magnet is iron-clad, thus being protected from mechanical injury. The resistance wire, the capacity of which is liberally proportioned, is wound on asbestos covered, metallic tubes through which a draft of air flows. While this draft of air very efficiently conveys the heat away from the resistance, yet it does not at any time touch the hot resistance wire; the obvious result being unusual freedom from oxidization of the resistance wire.

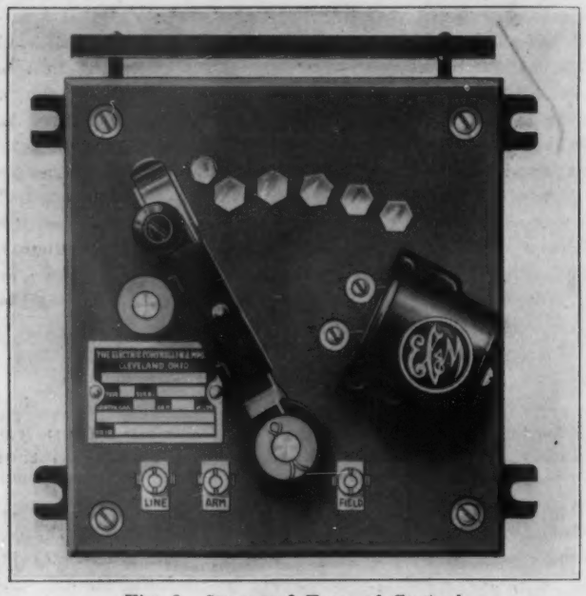


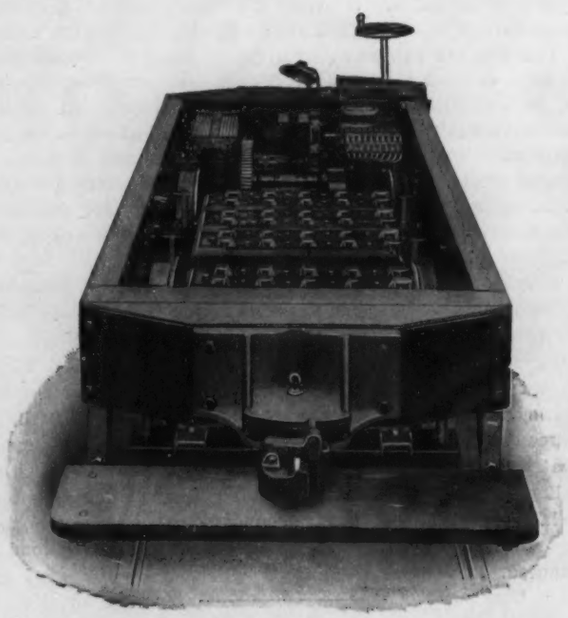
Fig. 2. Improved Type of Control.

The E. C. & M. Motor motor starting rheostats are regularly furnished in sizes from ¼ h.p. to 35 h.p., 110 volts and from ¼ h.p. to 50 h.p., 220 and 550 volts. Starters similar to Fig. 1 will be supplied for motors up to and including 7½ h.p., 110 volts, 15 h.p., 220 volts and 20 h.p., 550 volts. For larger sizes, the starter will be similar to Fig. 2.

STORAGE BATTERY LOCOMOTIVES.

The success of the storage battery equipment for electric vehicles has been so marked that it has been applied to electric cars, electric locomotives, etc. The storage battery locomotive is designed for service where a trolley system cannot be installed or is not desirable, and finds applications especially in short distance hauls at low speeds, such as over the industrial track in and about factory buildings, or where the conditions would require changing the trolley continually as in contractors' service. These locomotives may be built to carry their loads on the platform or to haul trailing loads.

The General Electric Company is now placing a storage battery locomotive on the market. The mechanical design is in accordance with the most approved and up-to-date practice. The frame consists of two steel I beam sides and two steel channel ends, carefully fitted at the joints and held rigidly together with steel angles and heavy bolts. The end frames are faced with wood bumpers to which suitable coupling devices are attached, these latter being designed to suit the customer's cars. The cast steel pedestal jaws which carry the journal boxes are bolted to the lower web of the side frames.



Arrangement of Storage Battery Locomotive Equipment.

The cast steel journal boxes are of special design and are fitted with roller bearings which ensure efficient mechanical transmission of power and so effects economy of battery current. The weight of the car is supported from the journal boxes by two heavy coiled springs.

Brake tension is effected by the screw and nut principle,

the brake spindle having a square thread on which a nut which carries an equalizing bar attached to the brake lever system, travels. This furnishes a very efficient method of braking, as a slight exertion only on the part of the operator is required and the brakes are automatically locked in any position without the use of pawls or rachets.

The wheels are pressed on and securely keyed to the axles. The axles are made of a special grade of steel and are case hardened at the journals so that there is very little wear either on the roller bearings or on the axles.

The motors used are of the automobile type designed to operate from batteries and have characteristics that effect the maximum possible economy in the use of battery current. They have high efficiency, large overload capacity and practically sparkless commutation. The high efficiency is obtained by designing them with a small air gap and running the iron at low densities. Furthermore, on account of the low densities the speed and torque characteristics are steeper than in the case of the ordinary series motors, a feature which tends to reduce the overload which can be thrown on the battery. The armature shaft rotates in ball bearings and consequently the friction losses are very light and the wear of the bearing is practically negligible. The motors are very compactly designed, yet they are readily accessible for inspection and repairs. They are also dust and moisture proof and are mounted in a cast steel suspension cradle, one side of which is supported on bearings on the axle while the other side is spring suspended from the locomotive frame, this manner of suspension being equivalent to standard railway practice. The motor drives the axle through double reduction gearing, an intermediate shaft, supported in the bearing housing and cast integral with the suspension cradle, carrying the intermediate gearing. As the service required of a storage battery locomotive is ordinarily performed at low speed, the use of the double reduction gearing permits slow speeds to be obtained without any rheostat losses and, due to the large gear reduction from armature shaft to wheel tread, very high tractive efforts are obtained at comparatively small current inputs to the motor. When carrying light loads these locomotives have speeds of from 4 to 5 miles per hour while on heavy loads the speed is from 2 to 2½ miles per hour.

The storage batteries are especially designed for the service, being very rugged in construction and due to the use of specially constructed plates have high ampere hour efficiency. The battery cells are grouped in four or more trays and are mounted in an angle iron crate which is spring suspended from the locomotive frame.

ANNUAL CONVENTION H. W. JOHNS-MANVILLE CO. ELECTRICAL DEPARTMENT MANAGERS AND SALESMEN.

On February fifth, there assembled in the new Manville Building, Madison avenue and Forty-first street, New York, over one hundred men who had arrived from all parts of the United States and Canada to attend the annual convention which the H. W. Johns-Manville Company hold for their electrical department managers and salesmen.

J. W. Perry, general electrical manager, called the convention to order and briefly outlined the purposes of the meeting. The first subject was "Modern Illumination", by W. H. Spencer, illuminating engineer of I. P. Frink Company, the sole selling agency of which has recently been acquired by the H. W. Johns-Manville Company. "J-M Linolite" was thoroughly taken up by W. S. Kilmer, the company's illuminating engineer. Actual service demonstrations were given in the evening of bank and desk reflectors, direct and indirect lighting fixtures and some new types of Frink electroliers and lighting novelties.

Tuesday was devoted to a discussion of "J-M Linolite Lamps" by J. F. Meyer; "Westinghouse Lamps" by Norman MacBeth and T. F. Fisher; all three of these men being connected with the Westinghouse Lamp Company. "J-M Transite Asbestos Wood" was discussed by S. A. Williams, W. D. Ligon, S. P. Russell and F. C. Reilly. "J-M Fibre Conduit" by W. D. Ligon and W. R. Seigle, "Overhead Line Material" by C. W. Schultz and W. D. Ligon; "Electrobestos Insulation and Diaelectric Cements" by J. R. McLain.

Wednesday was given up to "Friction Tapes and Splicing Compound," by J. W. Perry and H. M. Frantz. "J-M Electroliers" and special heating devices, by J. R. McLain; "J-M Air Brake Cylinder Packing Expanded Rings," by George Christensen; "J-M Dry Batteries," by E. Whitmore; "Lightning Arresters, Trolley Catchers and Retrievers," by W. R. Garton; "Asbestos Products for Electrical Power Plants," by L. R. Hoff.

Two special Pullman cars conveyed the convention representatives, on Wednesday evening, to Hartford, Conn., where the factory of the Johns-Pratt Company is located, and for which company the H. W. Johns-Manville Company are sole selling agents. Thursday morning the men assembled in the convention hall at the factory of the Johns-Pratt Company. J. W. Perry opened the meeting and President E. B. Hatch, of the Johns-Pratt Company, delivered an address of welcome. R. C. Cole, electrical engineer, occupied the entire morning with a discussion of "'Noark' Enclosed Fuses," and in the afternoon the subject of "'Noark' Service, Fuse and Subway Boxes" was handled by D. C. Hooker, assistant electrical engineer. The evening was spent in the testing laboratories of the factory, where many interesting tests of high tension fuses and boxes were made.

Friday was entirely given up to the discussion of "Insulating Materials and Overhead Line Material." The subjects were handled by A. G. Newton and R. B. Lattin, of the Johns-Pratt Company and C. W. Schultz, of the H. W. Johns-Manville Company.

On Saturday, the representatives devoted the morning to inspection of the factory, and in the afternoon an inspection of one of the substations of the Hartford Electric Light Company, where is installed a large quantity of "Noark" high voltage service boxes and fuses. R. C. Buell, secretary of the Johns-Pratt Company, delivered a very appropriate address at the conclusion of the meeting.

Saturday evening, a banquet was given to the representatives by the Johns-Pratt Company, at the Hartford Club, and in addition to those who attended the meetings all week, Mr. T. F. Manville, president of the H. W. Johns-Manville Company; J. E. Meek, manager of the railroad department; H. R. Trainer, manager of the Boston branch, and George F. Spencer, president of the I. P. Frink Company, were in attendance. The closing of the banquet concluded a very interesting and profitable convention, and throughout the entire proceedings the spirit of good fellowship and co-operation predominated, and all present declared it was the most profitable and enjoyable affair it had ever been their good fortune to attend.

NEW CATALOGS.

The Wisconsin Engine Company of Corliss, Wis., W. K. Thompson, Union Oil Building, Los Angeles, western sales manager, are distributing a neat booklet descriptive of the Wisconsin crude oil gas producer.

Smith, Booth, Usher Company of Los Angeles, have issued a well printed and bound 576 page catalog of the comprehensive line of machinery, supplies, pipe and fittings for the equipment of irrigation, power and mining plants, which they carry in stock.

Bulletin No. 23 from the Duncan Electric Manufacturing Company of Lafayette, Indiana, on Duncan Induction Type Watthour Meters for A. C. Service, is being distributed by G. A. Wilbur of San Francisco. This bulletin illustratets and describes this new type watthour meter in an interesting manner.

NEWS NOTES

INCORPORATIONS.

HILLSBORO, ORE.—Hillsboro Telephone Company, $25,000; shares $100 each; by O. G. and J. B. Wilkes and G. Stevens.

SAN BERNARDINO, CAL.—Articles of incorporation of the Interstate Telegraph Company, with the principal place of business at Carson City, Nev., have been filed, with $100,000 capital stock. The company will complete telegraph lines in Nevada and California.

LOS ANGELES, CAL.—Santa Barbara and Suburban Railway Company has incorporated with capital stock of $750,000. The incorporators are A. A. Maxwell of this city, L. J. Lee of Pasadena, and William Dieterle, E. A. Morphy and Herbert F. Keenman of this county. The Edison Electric Company is said to be interested in the concern.

ILLUMINATION.

CARLTON, ORE.—This town has voted water and light bonds, and work will be started soon.

ANACORTES, WASH.—Representatives of the Stone & Webster interests have asked for a franchise for furnishing electric lights and current for power purposes.

MERCED, CAL.—The San Joaquin Light & Power Company is making an estimate and gathering data for a power line extension to Atwater and the surrounding country.

REDMOND, ORE.—It is probable that the Redmond electric lighting plant will be doubled in the near future. It is suggested that the change be made from gasoline to wood fuel.

FRESNO, CAL.—By a vote of 5 to 3 the Board of City Trustees has passed to print an ordinance establishing dollar gas, the lower rate to be effective October 1, 1912, for one year.

WATSONVILLE, CAL.—W. H. McConnell of Monterey, successor to the Globe Electric Company, has been awarded the contract for constructing the new electrolier system for this city.

IDAHO FALLS, IDAHO.—An election will be held March 12, 1912, to decide the question of issuing $35,000 in bonds, the money to be used in constructing and maintaining a municipal water system and electric light plant.

NAPA, CAL.—At the meeting of the Board of Supervisors the Great Western Power Company presented an application for a franchise to operate an electric power and lighting company in this county. The board called for bids for the franchise to be opened April 9th, 1912.

ALAMEDA, CAL.—The finance committtee will submit to the City Council at the meeting on March 5 a bond proposition for $200,000 for fire department and electric light betterments. Of the total issue, $150,000 is designed for the electric light plant. A new building to house the plant, a new unit for additional generation, supplies for extension of distribution service and real estate for plant extension are included in $125,000 of the $150,000 allotted to the municipal light plant.

RANDSBURG, CAL.—The work on the power line of the Southern Sierras Power Company, is advancing rapidly. Crews are busy assembling the big 60-foot steel towers at present which will be set in a concrete foundation within a few days. The location for the Randsburg distributing station will be in Fiddler's gulch, about half a mile south or Butte avenue. About May 1 the power line will be finished and this town will be lighted by electricity.

OAKLAND, CAL.—The conference committee of the North Oakland improvement clubs recommended at a recent meeting the passage of a resolution calling upon the City Council to establish a definite sliding scale for the protection of the consumers. Since the three-cornered rate war was inaugurated by the Pacific Gas & Electric Company, the Great Western Power Company and the Central Oakland Light & Power Company, rates in the heart of the business section have been cut to 3c per kw. hour, while in districts unaffected by competition a rate of from 5c to 7c has been charged. The lower rate has been made where the cost of underground installation is from $8 to $10 a foot, and the higher charges have been maintained in the near-by districts where the installation expense is lower. Instances were cited by members of the committee showing that a rate of 7c is charged a block and a half district from a joint where the 3c rate is allowed. In the residential sections an average 6c rate is maintained.

PORTLAND, ORE.—There was an enormous increase in the commercial lighting business of the Portland Railway, Light & Power Company for the last quarter of 1911 over the preceding quarter. The figures for the quarter ending September 30, 1911, show that the receipts from commercial incandescents were $179,710.59. The receipts for the last quarter of the year had jumped to $250,052.61, an increase of $80,000, or 38.8 per cent. The receipts from residence incandescents showed a large increase also. During the quarter ending September 30 these amounted to $95,591.77. During the last quarter of the year the receipts totaled $120,209.42. A partial explanation of the growth lies perhaps in the fact that the nights were longer during the last quarter than they were in the preceding quarter. The company's total revenue from the lighting business during the last quarter was, according to the report, $632,340.45; the total expense of the lighting department was $143,432.68.

TELEPHONE AND TELEGRAPH.

DENISON, WASH.—The Denison Telephone Company has been organized here, with O. E. Daniels as president.

ENTERPRISE, ORE.—There will be a telephone line built from Enterprise to Swamp Creek, and from Paradise to Flora.

NEZ PERCE, IDAHO.—Idaho Farmers' Co-Operative Telephone Company has been incorporated by N. H. Jacob and associates.

GEORGETOWN, CAL.—The residents of the Dry Creek section between this place and Slatington, have decided to erect a farmers' telephone line.

TRANSMISSION.

BAKER, ORE.—The Eagle River Power Company has secured a franchise to run a power line from its plant on Eagle River to this city.

BELLINGHAM, WASH.—The Stone & Webster Corporation has made application to erect high power transmission line along Guide Meridian road from Canadian boundary to Bellingham.

TWIN FALLS, ORE.—The Thousand Springs Power Company has issued bonds to the extent of $1,500,000 to finance the new power project. Location Thousand Springs, 12 miles southeast of Bliss.

SHELTON, WASH.—J. E. Wickstrom has applied for a franchise to construct electric power and light poles along certain streets and alleys, also for constructing and maintaining underground conduits.

VANCOUVER, WASH.—The Washington-Oregon corporation is laying out lines for an electric road from here to Puget Sound, taking in Chehalis, Centralia, Olympia, etc. The power rights held by the Western Electric Company, a subsidiary concern, will be utilized on the Lewis River.

BREMERTON, WASH.—The Navy Department has rejected the application of the Elwha Power Company asking that the company's service, soon to be installed on the Olympic peninsula, be used by the government at the navy yard, Puget Sound. The government power plant has capacity sufficient for all present or contemplated needs.

BELLINGHAM, WASH.—In case the County Commissioners give Stone & Webster a franchise to construct pole lines to Lynden and Sumas in order to bring electric current to this city for the operation of the Bellingham & Skagit Interurban, which has been contracted from the Western Canada Company of British Columbia, the Stone & Webster people will expend $200,000 in the work. This is the statement made recently by one of the men prominently identified with the company. It is not anticipated that there will be any objection to the granting of the franchise, the hearing on which has been set for March 4. Notices have been posted throughout the county inviting any who have objections to make to appear on that date before the Board of County Commissioners. Some of the current thus secured will be used for lighting purposes by the town of Lynden.

MONTEREY, CAL.—The Monterey County Gas & Electric Company and the Monterey & Pacific Grove Railway Company have been sold to the Sierra and San Francisco Power Co., which is the United Railways of San Francisco. Besides the electric railway between Monterey and Pacific Grove and the light and power company of this city, the purchasers secure the light and water companies of Salinas. The Sierra and San Francisco Power Co. gets is power in the Sierras and has a transmission line as far as San Jose. That power line is to be extended to Salinas and power furnished to the Monterey and Salinas plants. The new owners purchased the Monterey and Pacific Grove Railway with the intention of making it the nucleus of an electric system that is to cover the whole of the Salinas Valley. It has been announced that the electric railway will be extended from Monterey to Salinas during the coming year.

SEATTLE, WASH.—The stockholders of the Seattle-Tacoma Power Company, at a special meeting last week voted unanimously to affiliate with the Puget Sound Traction, Light & Power Company recently organized for the purpose of taking over nearly all of the large light, power and traction companies in Western Washington. The stockholders ratified a report of the directors that the transfer be made. The action of the stockholders of the Seattle-Tacoma Company marks the passing of that corporation as an independent factor in the lighting and heating field. The company will lose its identity in the new company, which is capitalized at $40,000,000. Even the name will be changed in the near future. The Seattle-Tacoma Power Company developed the Snoqualmie Falls power station and in addition to furnishing power and light, operates a steam heating plant in the business district of the city. The Puget Sound Traction, Light & Power Company will in the near future take over the Seattle Electric Company, the Pacific Coast Power Company, the Whatcom County Railway and Light Company, and the Puget Sound Electric Company. All of the light, power and traction companies will be brought under the management.

TRANSPORTATION.

GLOBE, ARIZ.—Plans are now being formulated for building an electric road from Globe to Miami, and later through to Phoenix via Bellevue, Ray and Winkleman.

SAN FRANCISCO, CAL.—Treasurer McDougald has sold to the Union Trust Company $57,000 worth of 4½ per cent Geary street municipal railway bonds at par and accrued interest. The company bought for clients. McDougald has on hand $292,000 of the $400,000 block of the bonds last authorized.

GLENDALE, CAL.—Sealed bids will be received up to April 1st for the purchase of a franchise granting the right to operate for a period of 44 years an electric railroad on certain public streets of this city.

RICHMOND, CAL.—Superintendent W. R. Alberger of the Key Route systems, has announced that a rapid passenger service from Berkeley, connecting with the San Francisco ferry boats, will be extended to this city during the summer. A right of way has been secured. Alberger stated that branch lines connecting with the many manufacturing plants of the city, for carrying freight, are also contemplated by the company.

SAN FRANCISCO, CAL.—William M. Abbott, general attorney for the United Railroads, appeared before the public utilities committee of the Supervisors Wednesday, asking an extension of time on the Bancroft ordinance to compel the company to give direct service to the ferry on its Sutter street line, using the inner tracks. Without discussion further consideration was postponed one week, with the understanding that Abbott would, before the expiration of that time, present to the committee a proposition on behalf of the company looking toward a consummation of the demand.

PORTLAND, CAL.—In the street railway department of the Portland Railway, Light & Power Company, the revenue from the passenger traffic was $908,782.73 for the final quarter of the year. The receipts from freight hauling totaled $44,681.42 and from miscellaneous sources enough to bring the total to $989,578.95. The total operating expenses were $633,102.54. The company paid a dividend of $249,677.50. The number of passengers carried for revenue was 18,423,430. There were 4,225,252 transfers issued. The number of persons carried free of charge totaled 746,798. The report states that there are 271.28 miles of track in use.

SAN JOSE, CAL.—Within three months' time cars will be running between San Jose and Berryessa, if the plans under which the San Jose-Santa Clara Railway Company is working do not fail. The surveys have been completed, the rights-of-way secured as far as the boundary of Alum Rock Park, and the actual work of construction has begun. About a quarter of a mile of grading has been done in the Berryessa road east of Luna Park, and with a large crew of men the work is being pushed as rapidly as possible. A consignment of 5000 ties is already on the scene of activity, and 30,000 more are on the way to the construction camp. No preparations are be'ng made yet for the continuation of the line into Alum Rock Park, a city reservation, as the franchise through this property has not yet been obtained.

WATERWORKS.

SAN DIEGO, CAL.—Mayor J. E. Wadham vetoed the ordinance calling for special election to vote $600,000 sewer and water extension bonds.

UNION, ORE.—This city is to have a water system to cost $20,000. Two and one-half miles of 12 inch pipe will be put in. Water is to be taken from Catherine Creek.

GRANTS PASS, ORE.—H. L. Walther, manager of the Rogue River Electric Company at Medford, states that his company is coming to this section and will pump water on the land this summer.

MINNVILLE, ORE.—Carlton City is to issue bonds not to exceed $40,000 for water and light purposes. Water is to be taken from Panther Creek. A. L. Richardson, a Portland engineer, has been employed to make a survey. Work is to begin within a short time.

CORNELIUS, ORE.—This city has voted to bond itself for $27,000 for the purpose of installing a gravity water system. The supply will come from Roderick Creek, five miles from Forest Grove, and will be piped to Cornelius through seven miles of wood pipe.

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